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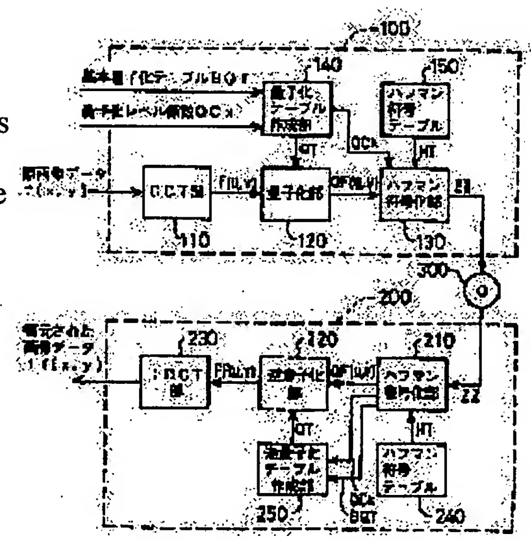
(54) METHOD AND DEVICE FOR COMPRESSING/EXTENDING IMAGE DATA

(57)Abstract:
PURPOSE: To reduce the data amount of compressed image data in comparison with the conventional data amount.
CONSTITUTION: The compressed image data contains code data showing a quantizing level coefficient QCx among block data. An inverse guantizing table preparation part 250 prepares a quantizing table QT by multiplying a DCT coefficient QF (u,v) provided by decoding compressed image data ZZ and the quantizing level coefficient QCx. An inverse quantizing part 220 performs inverse quantizing by using the quantizing table QT. Since the quantizing level coefficient QCx is inserted between the block data of the compressed image data, the quantizing table QT is updated each time the quantizing level coefficient QCx is decoded. On the other hand, data expressing plural continuous picture element blocks in the same pattern color are inserted to the compressed image data in any special data format (null run data).



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CLAIMS

[Claim(s)]
[Claim 1] Code data [as opposed to / are the approach of elongating the compression image data containing the code data obtained by carrying out orthogonal transformation of the image data, quantizing, and carrying out entropy code modulation further, and / the pixel block of (A) plurality], The 1st [to the 1st pixel block located in the head of a pixel block of said plurality] multiplier code, While generating the process for which the compression image data containing the 2nd [to the 2nd pixel block of arbitration] multiplier code is prepared, and the transform coefficient quantized by carrying out the entropy decryption of the (B) aforementioned code data the process which generates the 1st and the 2nd multiplier by carrying out the entropy decryption of said 1st and 2nd multiplier code, and (C) -- said the 1st and 2nd multiplier -- respectively -- ** -- by multiplying by the base quantity child-ized level of a predetermined base quantity child-ized table While reverse-quantizing the 1st, the process which creates the 2nd quantization table, and said quantized transform coefficient to the pixel block of the (D) above 1st on said 1st quantization table By reverse-quantizing said quantized transform coefficient to said 2nd pixel block on said 2nd quantization table the process which asks for the reverse-quantized transform coefficient, and (E) -- the expanding approach of the compression image data characterized by having the process which asks for the image data elongated by carrying out reverse orthogonal transformation of said transform coefficient by which reverse quantization was carried out.
[Claim 2] It is the expanding approach of compression image data according to claim 1. Said code data While two or more data units arranged according to the array sequence of a pixel block of said plurality are included The expanding approach of compression image data that said 1st multiplier code is arranged just before the 1st [to said 1st pixel block] data unit, and said 2nd multiplier code is arranged just before the 2nd [to said 2nd pixel block] data unit.
[Claim 3] It is the expanding approach of the compression image data which is an entropy symbolic language in the sign table on which it is the expanding approach of compression image data according to claim 2, and said 1st and 2nd multiplier code contains two or more entropy symbolic languages which receive the dc component of said the 1st, 2nd multiplier, and said transform coefficient.
[Claim 4] It is the expanding approach of compression image data including the process which is the expanding approach of compression image data according to claim 1, and reverse-quantizes said process (D) using said 1st quantization table to a series of pixel blocks from said 1st pixel block to the 3rd pixel block arranged just before said 2nd pixel block.
[Claim 5] It is the expanding approach of the compression image data which includes the process which sets up equally to said maximum the value of the quantization level on which said multiplication result exceeded said maximum when it is the expanding approach of compression image data according to claim 1 and, as for said process (C), the multiplication result of said the 1st and each of the 2nd multiplier, and the quantization level contained in said base quantity child-ized table exceeds predetermined maximum.
[Claim 6] It is the expanding approach of compression image data including the process made into the quantization level of said 1st and 2nd reverse quantization table as it is, without being the expanding

approach of compression image data according to claim 1, and said process (C) performing said multiplication substantially about the predetermined base quantity child-ized level in said base quantity child-ized table.
[Claim 7] It is the expanding approach of the compression image data which is the quantization level are the expanding approach of compression image data according to claim 6, and concerning [said predetermined base quantity child-ized level] the dc component of said transform coefficient.
[Claim 8] It is the expanding approach of compression image data according to claim 1. Said compression image data The same pattern block data which shows the number of two or more continuous pixel blocks which has the same image pattern is included. Further furthermore, said process (B) In case said quantized transform coefficient to said two or more pixel blocks expressed with said same pattern block data is created, while setting the predetermined component of said transform coefficient as the value specified beforehand The expanding approach of the compression image data which has the process created by setting the value of the component of said transform coefficients other than said predetermined component as zero.
[Claim 9] It is the expanding approach of compression image data that it is the expanding approach of compression image data according to claim 8, and said predetermined component is a dc component.
[Claim 10] It is the expanding approach of compression image data including the process which is the expanding approach of compression image data according to claim 8, and omits said reverse quantization about said transform coefficient by which said process (D) was decrypted from said same pattern block data.
[Claim 11] Code data [as opposed to / are the approach of elongating the compression image data containing the code data obtained by carrying out orthogonal transformation of the image data,, quantizing, and carrying out entropy code modulation further, and / the 1st pixel block of (A) plurality], The process for which the compression image data containing the same pattern block data which shows the number of the 2nd continuous pixel block of plurality which has the same image pattern is prepared, (B) While creating the transform coefficient by which the 1st to said two or more 1st pixel blocks was quantized by carrying out the entropy decryption of said code data In case the transform coefficient by which the 2nd to said two or more 2nd pixel blocks expressed with said same pattern block data was quantized is created, while setting the predetermined component of said transform coefficient as the value specified beforehand The process which creates said transform coefficient by which the 2nd was quantized by setting the value of the component of said transform coefficients other than said predetermined component as zero, (C) by reverse-quantizing using a quantization table, said transform coefficient by which the 1st and the 2nd were quantized The expanding approach of the compression image data characterized by having the process which creates the 1st, the process which asks for the transform coefficient by which the 2nd was reverse-quantized, and the image data elongated by carrying out reverse orthogonal transformation of the transform coefficient by which the 2nd was reverse-quantized to the (D) above 1st.
[Claim 12] Code data [as opposed to / are equipment which elongates the compression image data containing the code data obtained by carrying out orthogonal transformation of the image data, quantizing and carrying out entropy code modulation further, and / two or more pixel blocks], The 1st [to the 1st pixel block located in the head of a pixel block of said plurality] multiplier code, While generating the transform coefficient quantized a storage means to memorize the compression image data containing the 2nd [to the 2nd pixel block of arbitration] multiplier code, and by carrying out the entropy decryption of said code data An entropy decryption means to generate the 1st and the 2nd multiplier by carrying out the entropy decryption of said 1st and 2nd multiplier code, By multiplying by said the 1st and each of the 2nd multiplier, and the base quantity child-ized level of a predetermined base quantity child-ized table While reverse-quantizing said quantized transform coefficient to the 1st, a reverse quantization table creation means to create the 2nd quantization table, and said 1st pixel block, on said 1st quantization table By reverse-quantizing said quantized transform coefficient to said 2nd pixel block on said 2nd quantization table The expanding approach of the compression image data characterized by having a reverse quantization means to ask for the reverse-quantized transform

coefficient, and a reverse orthogonal transformation means to ask for the image data elongated by carrying out reverse orthogonal transformation of said transform coefficient by which reverse quantization was carried out.
[Claim 13] It is expanding equipment of compression image data according to claim 12. Said code data While two or more data units arranged according to the array sequence of a pixel block of said plurality are included Expanding equipment of compression image data with which said 1st multiplier code is arranged just before the 1st [to said 1st pixel block] data unit, and said 2nd multiplier code is arranged just before the 2nd [to said 2nd pixel block] data unit.
[Claim 14] It is expanding equipment of the compression image data which is an entropy symbolic language in the sign table on which it is expanding equipment of compression image data according to claim 13, and said 1st and 2nd multiplier code contains two or more entropy symbolic languages which receive the dc component of said the 1st, 2nd multiplier, and said transform coefficient.
[Claim 15] It is expanding equipment of compression image data including a means to be expanding equipment of compression image data according to claim 12, and to reverse-quantize said reverse quantization means using said 1st quantization table to a series of pixel blocks to the 3rd pixel block arranged just before said 2nd pixel block from said 1st pixel block.
[Claim 16] It is expanding equipment of the compression image data which includes a clipping means set up equally to said maximum the value of the quantization level on which said multiplication result exceeded said maximum when it is expanding equipment of compression image data according to claim 12 and, as for said reverse quantization table creation means, the multiplication result of said the 1st and each of the 2nd multiplier, and the quantization level contained in said base quantity child-ized table exceeds predetermined maximum.
[Claim 17] It is expanding equipment of compression image data including the means which makes said multiplication the quantization level of said 1st and 2nd reverse quantization table as it is about base quantity child-ized level are expanding equipment of compression image data according to claim 12, and predetermined [in said base quantity child-ized table] in said reverse quantization table creation means, without carrying out substantially.
[Claim 18] It is expanding equipment of the compression image data which is the quantization level are expanding equipment of compression image data according to claim 17, and concerning [said predetermined base quantity child-ized level] the dc component of said transform coefficient.
[Claim 19] It is expanding equipment of compression image data according to claim 12. Said compression image data The same pattern block data which shows the number of two or more continuous pixel blocks which has the same image pattern is included. Further said entropy decryption means In case said quantized transform coefficient to said two or more pixel blocks expressed with said same pattern block data is created, while setting the predetermined component of said transform coefficient as the value specified beforehand Expanding equipment of the compression image data which has a means to create by setting the value of the component of said transform coefficients other than said predetermined component as zero.
[Claim 20] It is expanding equipment of the compression image data said whose predetermined component it is expanding equipment of compression image data according to claim 19, and is a dc component.
[Claim 21] It is expanding equipment of compression image data including a means to be expanding equipment of compression image data according to claim 19, and to bypass said transform coefficient by which said entropy decryption means was decrypted from said same pattern block data, and to supply said reverse quantization means for it to said reverse orthogonal transformation means.
[Claim 22] Code data [as opposed to / are equipment which elongates the compression image data containing the code data obtained by carrying out orthogonal transformation of the image data, quantizing, and carrying out entropy code modulation further, and / two or more 1st pixel blocks], The 1st storage means which memorizes the compression image data containing the same pattern block data which shows the number of the 2nd continuous pixel block of plurality which has the same image pattern, The 2nd storage means which memorizes the assignment value over the predetermined

component of the transform coefficient about said two or more 2nd pixel blocks, While creating the transform coefficient by which the 1st to said two or more 1st pixel blocks was quantized by carrying out the entropy decryption of said code data In case the transform coefficient by which the 2nd to said two or more 2nd pixel blocks expressed with said same pattern block data was quantized is created An entropy decryption means to create the transform coefficient by which the 2nd was quantized by setting the value of said transform coefficients other than said predetermined component as zero while setting said predetermined component as the assignment value memorized by said 2nd storage means, By reverse-quantizing using a quantization table, said transform coefficient by which the 1st and the 2nd were quantized Expanding equipment of the compression image data characterized by having a reverse orthogonal transformation means to create the image data elongated the 1st, a reverse quantization means to ask for the transform coefficient by which the 2nd was reverse-quantized, and by carrying out reverse orthogonal transformation of the transform coefficient by which the 2nd was reverse-quantized to said 1st [the].
[Claim 23] The process which is the compression approach of image data, carries out orthogonal transformation of the (A) image data for two or more pixel blocks of every in an image, and asks for a transform coefficient, (B) The 1st multiplier to the 1st pixel block located in the head of said pixel blocks of two or more, the process which specifies the 2nd multiplier to the 2nd pixel block of arbitration, and (C) -- said the 1st and 2nd multiplier -- respectively -- ** -- by multiplying by the base quantity child-ized level of a predetermined base quantity child-ized table The 1st, the process which creates the 2nd quantization table, and by quantizing said transform coefficient to the (D) above 1st and the 2nd pixel block on said 1st and 2nd quantization table, respectively While creating code data by carrying out entropy code modulation of the transform coefficient by which the (E) aforementioned quantization was carried out to the process which asks for the quantized transform coefficient The compression approach of the image data characterized by having the process which creates the compression image data which contains the 1st, the process which creates the 2nd multiplier code, and the (F) aforementioned code data, said 1st [the] and the 2nd multiplier code by carrying out entropy code modulation of said the 1st and 2nd multiplier.
[Claim 24] It is the compression approach of image data which is the compression approach of image data according to claim 23, and contains said 2nd multiplier code just before the 2nd [to said 2nd pixel block] data unit just before the 1st [to said 1st pixel block] data unit including said 1st multiplier code while said code data contains two or more data units arranged according to the array sequence of a pixel block of said plurality.
[Claim 25] It is the compression approach of the image data which is the compression approach of image data according to claim 24, and includes the process which carries out entropy code modulation of said the 1st and 2nd multiplier using the sign table on which said process (E) contains two or more entropy symbolic languages which receive the dc component of said the 1st, 2nd multiplier, and said transform coefficient.
[Claim 26] It is the compression approach of the image data which is the compression approach of image data according to claim 23, and includes the process which creates the compression image data in which said process (F) contains said same pattern block data with said code data and said 1st and 2nd multiplier code including the process at which said process (E) creates the same pattern block data which shows the number of two or more continuous pixel blocks which has the same image pattern.
[Claim 27] Code data [as opposed to / are the approach of elongating the compression image data containing the code data obtained by carrying out orthogonal transformation of the image data, quantizing, and carrying out entropy code modulation further, and / the pixel block of (A) plurality], The process for which the compression image data containing the 1st [to the 1st pixel block of the arbitration of the pixel blocks of said plurality] multiplier code is prepared, and by carrying out the entropy decryption of the (B) aforementioned code data The process which generates the 1st multiplier by carrying out the entropy decryption of said 1st multiplier code while generating the quantized transform coefficient, (C) by multiplying by said 1st multiplier and the base quantity child-ized level of a predetermined base quantity child-ized table By reverse-quantizing the process which creates the 1st

quantization table, and said quantized transform coefficient to at least one pixel block including the pixel block of the (D) above 1st on said 1st quantization table the process which asks for the reverse-quantized transform coefficient, and (E) -- the expanding approach of the compression image data characterized by having the process which asks for the image data elongated by carrying out reverse orthogonal transformation of said transform coefficient by which reverse quantization was carried out.
[Claim 28] It is the expanding approach of compression image data according to claim 27. Said compression image data The 2nd [to the 2nd pixel block arranged after said 1st pixel block] multiplier code is included. Furthermore, said process (B) The process which generates the 2nd multiplier by carrying out the entropy decryption of said 2nd multiplier code is included. Said process (C) The process which creates the 2nd quantization table by multiplying by said 2nd multiplier and the base quantity child-ized level of said base quantity child-ized table is included. Said process (D) While reverse-quantizing using said 1st quantization table, said quantized transform coefficient to a series of pixel blocks to the 3rd pixel block arranged from said 1st pixel block just before said 2nd pixel block The expanding approach of compression image data including the process which reverse-quantizes said quantized transform coefficient to at least one pixel block including said 2nd pixel block on said 2nd quantization table.
[Claim 29] It is the expanding approach of compression image data according to claim 28. Said code data While two or more data units arranged according to the array sequence of a pixel block of said plurality are included The expanding approach of compression image data that said 1st multiplier code is arranged just before the 1st [to said 1st pixel block] data unit, and said 2nd multiplier code is arranged just before the 2nd [to said 2nd pixel block] data unit.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the approach of compressing and elongating image data, and the equipment for it.
[0002]
[Description of the Prior Art] Drawing 31 is the block diagram showing the configuration of compression/expanding equipment of the conventional image data. After it carries out orthogonal transformation of the subject-copy image data for every block of a MxN pixel in the orthogonal transformation section 542, image data compression equipment 540 quantizes in the quantization section 544, further, encodes in the entropy-code-modulation section 546, and creates compression image data. On the other hand, image data decompression equipment 550 restores image data by the reverse orthogonal transformation section 552, after decrypting compression image data in the entropy decryption section 556 first and reverse-quantizing in the reverse quantization section 554. In addition, the quantization section 544 and the reverse quantization section 554 use the same quantization table 562, and use the same sign table 564 also for the entropy-code-modulation section 546 and the entropy decryption section 556.
[0003]
[Problem(s) to be Solved by the Invention] By the way, the 1st part to restore by high definition in one image and the 2nd part which may be restored by low image quality may be included. In such a case, what is necessary is to quantize using the small quantization table of quantization level to the 1st part, and just to quantize using the big quantization table of quantization level to the 2nd part. A quantization table is the matrix of the same size as the pixel block of image data, i.e., the matrix of a M line N train. With the conventional image data compression / expanding equipment, when two or more quantization tables were used in one image, two or more quantization tables of a M line N train had to be transmitted to expanding equipment 550 from the compression equipment 540, and there was a problem of increasing the amount of data of compression image data.
[0004] Moreover, entropy code modulation of all the orthogonal transformation multipliers of the M line N train over those pixel blocks is carried out also with a simple image part in which the pixel block which has a uniform color continues into an image. Therefore, the compression image data showing such a simple image part also had the problem of becoming the remarkable amount of data.
[0005] This invention is made in order to solve the above-mentioned technical problem in the conventional technique, and it aims at offering the technique in which the amount of data of compression image data can be reduced compared with the former.
[0006]
[Means for Solving the Problem and its Function] In order to solve an above-mentioned technical problem, the compression image data decompression approach by this invention (A) The code data to two or more pixel blocks, and the 1st [to the 1st pixel block located in the head of said pixel blocks of two or more] multiplier code, While generating the process for which the compression image data

containing the 2nd [to the 2nd pixel block of arbitration] multiplier code is prepared, and the transform coefficient quantized by carrying out the entropy decryption of the (B) aforementioned code data the process which generates the 1st and the 2nd multiplier by carrying out the entropy decryption of said 1st and 2nd multiplier code, and (C) -- said the 1st and 2nd multiplier -- respectively -- ** -- by multiplying by the base quantity child-ized level of a predetermined base quantity child-ized table While reverse-quantizing the 1st, the process which creates the 2nd quantization table, and said quantized transform coefficient to the pixel block of the (D) above 1st on said 1st quantization table By reverse-quantizing said quantized transform coefficient to said 2nd pixel block on said 2nd quantization table It has the process which asks for the elongated image data by carrying out reverse orthogonal transformation of the transform coefficient by which the (E) aforementioned reverse quantization was carried out to the process which asks for the reverse-quantized transform coefficient.
[0007] Since the 1st and 2nd quantization table on which quantization level differs can be created only by giving the 1st and the 2nd multiplier, compared with the case where two quantization tables are included in compression image data, the amount of data of compression image data can be reduced.
[0008] While said code data contains two or more data units arranged according to the array sequence of a pixel block of said plurality, said 1st multiplier code is arranged just before the 1st [to said 1st pixel block] data unit, and said 2nd multiplier code may be made to be arranged just before the 2nd [to said 2nd pixel block] data unit.
[0009] If it carries out like this, the 1st and the 2nd multiplier are easily matched with the 1st and 2nd pixel block, respectively.
[0010] Moreover, as for said 1st and 2nd multiplier code, it is desirable that it is an entropy symbolic language in the sign table containing two or more entropy symbolic languages which receive the dc component of said the 1st, 2nd multiplier, and said transform coefficient.
[0011] if it carries out like this -- the 1st and the 2nd multiplier -- a meaning -- and it can decode in an instant.
[0012] As for said process (D), it is desirable to make it include the process reverse-quantized using said 1st quantization table to a series of pixel blocks from said 1st pixel block to the 3rd pixel block arranged just before said 2nd pixel block.
[0013] Since the 1st multiplier is applied to two or more pixel blocks until the 2nd multiplier appears, it is not necessary to include the 1st multiplier before each code data of a pixel block of these plurality.
[0014] When the multiplication result of said the 1st and each of the 2nd multiplier, and the quantization level contained in said base quantity child-ized table exceeds predetermined maximum, you may make it said process (C) include the process which sets up equally to said maximum the value of the quantization level for which said multiplication result exceeded said maximum.
[0015] If it carries out like this, the number of bits of quantization level can be maintained below at constant value.
[0016] You may make it said process (C) include the process made into the quantization level of said 1st and 2nd reverse quantization table as it is about the predetermined base quantity child-ized level in said base quantity child-ized table, without performing said multiplication substantially.
[0017] If it carries out like this, the error generated in case the transform coefficient of a position is reverse-quantized can be reduced.
[0018] Said predetermined base quantity child-ized level has [making it be the quantization level about the dc component of said transform coefficient] a desirable thing.
[0019] If it is made not to change the quantization level to the dc component of a transform coefficient, the error accompanying reverse quantization of a dc component can be reduced.
[0020] Said compression image data contains the same pattern block data which shows the number of two or more continuous pixel blocks which has the still more nearly same image pattern. Further said process (B) In case said quantized transform coefficient to said two or more pixel blocks expressed with said same pattern block data is created, while setting the predetermined component of said transform coefficient as the value specified beforehand You may make it have the process created by setting the value of the component of said transform coefficients other than said predetermined component as zero.

[0021] If it carries out like this, comparatively little data can express two or more continuous pixel blocks which have the same image pattern of each other.
[0022] As for said predetermined component, it is desirable that it is a dc component.
[0023] If it carries out like this, two or more continuous pixel blocks can be applied in the same color.
[0024] You may make it said process (D) include the process which omits said reverse quantization about said transform coefficient decrypted from said same pattern block data.
[0025] If it carries out like this, generating of the error by reverse quantization can be prevented.
[0026] Other compression image data decompression approaches by this invention (A) The process for which the compression image data containing the code data to two or more 1st pixel blocks and the same pattern block data which shows the number of two or more 2nd continuous pixel blocks which has the same image pattern is prepared, (B) While creating the transform coefficient by which the 1st to said two or more 1st pixel blocks was quantized by carrying out the entropy decryption of said code data In case the transform coefficient by which the 2nd to said two or more 2nd pixel blocks expressed with said same pattern block data was quantized is created, while setting the predetermined component of said transform coefficient as the value specified beforehand The process which creates said transform coefficient by which the 2nd was quantized by setting the value of the component of said transform coefficients other than said predetermined component as zero, (C) by reverse-quantizing using a quantization table, said transform coefficient by which the 1st and the 2nd were quantized It has the process which creates the elongated image data the 1st, the process which asks for the transform coefficient by which the 2nd was reverse-quantized, and by carrying out reverse orthogonal transformation of the transform coefficient by which the 2nd was reverse-quantized to the (D) above 1st.

[0027] Comparatively little data can express two or more continuous pixel blocks which have the color of the same pattern mutually by this approach.
[0028] Code data [as opposed to two or more pixel blocks in the compression image data decompression equipment by this invention], The 1st [to the 1st pixel block located in the head of a pixel block of said plurality] multiplier code, While generating the transform coefficient quantized a storage means to memorize the compression image data containing the 2nd [to the 2nd pixel block of arbitration] multiplier code, and by carrying out the entropy decryption of said code data An entropy decryption means to generate the 1st and the 2nd multiplier by carrying out the entropy decryption of said 1st and 2nd multiplier code, By multiplying by said the 1st and each of the 2nd multiplier, and the base quantity child-ized level of a predetermined base quantity child-ized table While reverse-quantizing said quantized transform coefficient to the 1st, a reverse quantization table creation means to create the 2nd quantization table, and said 1st pixel block, on said 1st quantization table By reverse-quantizing said quantized transform coefficient to said 2nd pixel block on said 2nd quantization table It has a reverse quantization means to ask for the reverse-quantized transform coefficient, and a reverse orthogonal transformation means to ask for the image data elongated by carrying out reverse orthogonal transformation of said transform coefficient by which reverse quantization was carried out.
[0029] Moreover, other compression image data decompression equipments by this invention The 1st storage means which memorizes the compression image data containing the code data to two or more 1st pixel blocks, and the same pattern block data which shows the number of the 2nd continuous pixel block of plurality which has the same image pattern, The 2nd storage means which memorizes the assignment value over the predetermined component of the transform coefficient about said two or more 2nd pixel blocks, While creating the transform coefficient by which the 1st to said two or more 1st pixel blocks was quantized by carrying out the entropy decryption of said code data In case the transform coefficient by which the 2nd to said two or more 2nd pixel blocks expressed with said same pattern block data was quantized is created An entropy decryption means to create the transform coefficient by which the 2nd was quantized by setting the value of said transform coefficients other than said predetermined component as zero while setting said predetermined component as the assignment value memorized by said 2nd storage means, By reverse-quantizing using a quantization table, said transform coefficient by which the 1st and the 2nd were quantized It has a reverse orthogonal transformation means to create the

elongated image data, the 1st, a reverse quantization means to ask for the transform coefficient by which the 2nd was reverse-quantized, and by carrying out reverse orthogonal transformation of the transform coefficient by which the 2nd was reverse-quantized to said 1st [the].
[0030] The process which the compression approach of the image data based on this invention carries out orthogonal transformation of the (A) image data for two or more pixel blocks of every in an image, and asks for a transform coefficient, (B) The 1st multiplier to the 1st pixel block located in the head of said pixel blocks of two or more, the process which specifies the 2nd multiplier to the 2nd pixel block of arbitration, and (C) -- said the 1st and 2nd multiplier -- respectively -- ** -- by multiplying by the base quantity child-ized level of a predetermined base quantity child-ized table The 1st, the process which creates the 2nd quantization table, and by quantizing said transform coefficient to the (D) above 1st and the 2nd pixel block on said 1st and 2nd quantization table, respectively While creating code data by carrying out entropy code modulation of the transform coefficient by which the (E) aforementioned quantization was carried out to the process which asks for the quantized transform coefficient It has the process which creates the compression image data containing the 1st, the process which creates the 2nd multiplier code, and the (F) aforementioned code data, said 1st [the] and the 2nd multiplier code by carrying out entropy code modulation of said the 1st and 2nd multiplier.
[0031] Since the 1st and 2nd quantization table on which quantization level differs can be created only by giving the 1st and the 2nd multiplier, compared with the case where two quantization tables are included in compression image data, the amount of data of compression image data can be reduced.
[0032] The approach of elongating other compression image data to the pan by this invention (A) The process for which the compression image data containing the code data to two or more pixel blocks and the 1st [to the 1st pixel block of the arbitration of said two or more pixel blocks] multiplier code is prepared, (B) While generating the transform coefficient quantized by carrying out the entropy decryption of said code data By multiplying by the process which generates the 1st multiplier by carrying out the entropy decryption of said 1st multiplier code, the 1st multiplier of (C) above, and the base quantity child-ized level of a predetermined base quantity child-ized table By reverse-quantizing the process which creates the 1st quantization table, and said quantized transform coefficient to at least one pixel block including the pixel block of the (D) above 1st on said 1st quantization table It has the process which asks for the elongated image data by carrying out reverse orthogonal transformation of the transform coefficient by which the (E) aforementioned reverse quantization was carried out to the process which asks for the reverse-quantized transform coefficient.
[0033] [0034] which can reduce the amount of data of compression image data compared with the case where two quantization tables are included in compression image data since the 1st and 2nd quantization table on which quantization level differs can be created only by giving the 1st and the 2nd multiplier, if it carries out like this Said compression image data contains further the 2nd [to the 2nd pixel block arranged after said 1st pixel block] multiplier code. Said process (B) The process which generates the 2nd multiplier by carrying out the entropy decryption of said 2nd multiplier code is included. Said process (C) The process which creates the 2nd quantization table by multiplying by said 2nd multiplier and the base quantity child-ized level of said base quantity child-ized table is included. Said process (D) While reverse-quantizing using said 1st quantization table, said quantized transform coefficient to a series of pixel blocks to the 3rd pixel block arranged from said 1st pixel block just before said 2nd pixel block It is desirable to make it include the process which reverse-quantizes said quantized transform coefficient to at least one pixel block including said 2nd pixel block on said 2nd quantization table.
[0035] If it carries out like this, it can quantize by using two quantization tables at the time of expanding of compression image data only by including the 1st and 2nd multiplier code in compression image data.

[0036]
[Example] Below, sequential explanation is performed about each following item.
A. The whole compression/expanding equipment configuration and basic actuation;
B. Adjustment of the quantization table QT by the quantization level multiplier QCx;
C. Huffman coding and configuration of compressed data;

D. Detail configuration of the reverse quantization table creation section;
E. null -- a decryption [0037] of run data A. The configuration and actuation of compression/expanding equipment : drawing 1 is the block diagram showing the function of the compression equipment 100 of image data, and expanding equipment 200 which applied one example of this invention.

[0038] Image data compression equipment 100 is equipped with the DCT section 110 which performs discrete cosine conversion to the subject-copy image data f (x y), the quantization section 120 which quantizes the transform coefficient F (u, v) obtained by DCT conversion, the Huffman coding section 130 which carries out Huffman coding of the quantized transform coefficient QF (u, v), and creates the compression image data ZZ, the quantization table creation section 140, and the Huffman-coding table memory 150. The quantization table creation section 140 creates the quantization table QT based on the base quantity child-ized table BQT and the quantization level multiplier QCx so that it may mention later. The compression image data ZZ is memorized by storages, such as CD-ROM, and is supplied to image data decompression equipment 200 from image data compression equipment 100.

[0039] Image data decompression equipment 200 is equipped with the Huffman decryption section 210 which carries out the Huffman decryption of the compression image data ZZ, the reverse quantization section 220 which reverse-quantizes the transform coefficient QF (u, v) after the decoded quantization, the IDCT section 230 which performs discrete cosine inverse transformation to the reverse-quantized transform coefficient FF (u, v), and obtains image data ff (x y), the Huffman-coding table memory 240, and the reverse quantization table creation section 250. The reverse quantization table creation section 250 creates the quantization table QT for the base quantity child-ized table BQT and the quantization level multiplier QCx which were decoded from the compression image data ZZ based on a receipt and these from the Huffman decryption section 210. This quantization table QT is the same as the quantization table QT used with the compression equipment 100. Moreover, the Huffman-coding table HT memorized by the Huffman-coding table memory 240 is the same as what is memorized by the Huffman-coding table memory 150 of a compression equipment 100.

[0040] Drawing 2 is the block diagram showing the concrete configuration of image data compression equipment 100. This image data compression equipment 100 is equipped with CPU101, main memory 102, a keyboard 103, a mouse 104, a magnetic disk drive 105, and optical-magnetic disc equipment 106. Each processing sections 110-140 of the image data compression equipment 100 shown in drawing 1 are realized by the software program memorized by main memory 102. Moreover, the base quantity child-ized table BQT and the Huffman-coding table HT are memorized by the magnetic disk drive 105. This image data compression equipment 100 is a workstation for creating video game, and various kinds of programs for creating the video game other than the software program for image data compression are performed by CPU101. The completed game program is stored in optical-magnetic disc equipment 106 with compression image data. And CD-ROM containing the program and compression image data of video game is manufactured using this magneto-optic disk.

[0041] Drawing 3 is the block diagram showing the configuration of the video game equipment 20 containing image data decompression equipment 200. The microprocessor 40 which manages in generalization all processings about others, an image processing, and this (henceforth MPU), [CD-ROM drive / 32 / to which this video game equipment 20 was connected through the SCSI bus 36] The main memory 41 by which direct continuation was carried out to this MPU40 (it is hereafter called M-RAM), The various units connected to the bus (M-BUS) 43 of ROM42 and MPU40 which similarly memorized the BIOS program, That is, it has the picture signal control unit 45, the image data decompression unit 200, the VDP unit 49 that outputs a specific picture signal, the video encoder unit 50 which performs composition and the output of a video signal, and the voice data output unit 52 treating voice data.

[0042] Moreover, the memory connected to the local bus (K-BUS) 54 of the picture signal control unit 45 into this video game equipment 20 The memory connected to the local bus of 55 and the image data decompression unit 200 (It is hereafter called K-RAM) The video memory connected to the local bus of 251 and the VDP unit 49 (It is hereafter called R-RAM) (It is hereafter referred to as V=RAM) The output signal from 59 and the video encoder unit 50 is changed into the usual video signal (NTSC), and it has the NTSC converter 60 outputted to color television 28.

[0043] The picture signal control unit 45, the image data decompression unit 200, the video encoder unit 50, and the voice data output unit 52 are constituted by the logical circuit, respectively.
[0044] Drawing 4 (A) is the top view showing an example of the subject-copy image used as the background image of a game. This subject-copy image is an image with which volcanic natural drawing was inserted in the background BG applied in the uniform color. Drawing 4 (B) expands and shows some subject-copy images including one pixel block PB. Generally, the pixel block PB can be set up so that the pixel PX of a MxN individual may be included. As a value of two integers M and N, 8 or 16 are desirable and is M=N=8 in this example. In addition, integers M and N may be set as a different value. The amount of [which expresses Background BG in the compression image data ZZ] data division have a special data format (null run data) showing that the pixel block PB of a uniform color continues so that it may mention later.
[0045] The DCT section 110 of image data compression equipment 100 performs two-dimensional DCT conversion for every pixel block PB according to the following formula 1.
[Equation 1]

$$F(u,v) = \frac{1}{4} C(u)C(v) \sum_{x=0}^{7} \sum_{y=0}^{7} f(x,y) \cos\frac{\pi(2x+1)u}{16} \cos\frac{\pi(2y+1)v}{16}$$

$$C(u),\ C(v) = \frac{1}{\sqrt{2}} \quad (u,\ v = 0\ \text{の時})$$

$$= 1 \quad (u,\ v \neq 0\ \text{の時})$$

Here, the array of a transform coefficient, and u and v of the coordinate and F (u, v) the array of 8x8 image data by which f (x y) is contained in one pixel block PB, x, and y indicate the location of each pixel within each pixel block PB to be are the coordinates of frequency space.
[0046] Drawing 5 is the explanatory view showing the array of a transform coefficient F (u, v). A transform coefficient F (u, v) is the same array of 8x8 as the pixel block PB. The transform coefficient F of an upper left edge (0 0) is called DC component (or DC multiplier), and other transform coefficients are called AC component (or AC multiplier). DC component shows the average of the image data in the pixel block PB. Moreover, AC component shows change of the image data within the pixel block PB. Since the image data of the adjoining pixel has a certain amount of correlation, the value of a low-frequency component is comparatively large in AC multiplier, and the value of a high frequency component is comparatively small. Moreover, the effect which it has on image quality has a comparatively small high frequency component.
[0047] Drawing 6 is the explanatory view showing basic actuation of image data compression equipment 100 and image data decompression equipment 200. The DCT section 110 creates the DCT multiplier F (u, v) shown in drawing 6 (a).
[0048] The quantization table creation section 140 creates the quantization table QT (drawing 6 (d)) by multiplying by the base quantity child-ized table BQT (drawing 6 (c)) and the quantization level multiplier QCx, as shown in the following formula 2.
[Equation 2]

$$QT(u, v) = QCx \times BQT(u, v)$$

[0049] Since it is QCx=1 in the example of drawing 6 , the quantization table QT is the same as the base quantity child-ized table BQT.
[0050] The quantization section 120 asks for the quantized DCT multiplier QF (u, v) which is shown in drawing 6 (b) by carrying out linear quantization of the DCT multiplier F (u, v) on the quantization table QT. Linear quantization is processing which does a division and rounds off the division result for an integer.
[0051] The Huffman coding section 130 creates the compression image data ZZ (drawing 6 (e)) by carrying out Huffman coding of this DCT multiplier QF (u, v). In addition, about the approach of

Huffman coding, it mentions later further. The compression image data ZZ contains the 1st data showing the base quantity child-ized table BQT, and the 2nd data showing the quantization level multiplier QCx and a transform coefficient QF (u, v) so that it may mention later.
[0052] If the compression image data ZZ is given to image data decompression equipment 200, the Huffman decryption section 210 will decrypt the compression image data ZZ, and it will ask for the DCT multiplier QF (u, v) (drawing 6 (f)). Since Huffman coding is reversible coding, this DCT multiplier QF (u, v) is the same as the DCT multiplier QF (u, v) (drawing 6 (b)) after the quantization called for by the quantization section 120 of image data compression equipment 100. In addition, the Huffman decryption section 210 also decrypts the base quantity child-ized table BQT (drawing 6 (c)) and the quantization level multiplier QCx which are contained in the compression image data ZZ other than the DCT multiplier QF (u, v), and is given to the reverse quantization table creation section 250.
[0053] The reverse quantization table creation section 250 creates the quantization table QT (drawing 6 (d)) by carrying out the multiplication of the base quantity child-ized table BQT and the quantization level multiplier QCx. The reverse quantization section 220 carries out the multiplication of this quantization table QT and the DCT multiplier QF (u, v), and asks for the decoded DCT multiplier FF (u, v) which is shown in drawing 6 (g).
[0054] The IDCT section 230 performs two-dimensional DCT inverse transformation shown in the following formula 3 to this DCT multiplier FF (u, v), and creates the restored image data ff (x y).
[Equation 3]

$$ff(x,y) = \frac{1}{4}\sum_{u=0}^{7}\sum_{v=0}^{7} C(u)C(v)\, FF(u,v) \cos\frac{\pi(2x+1)u}{16} \cos\frac{\pi(2y+1)v}{16}$$

$$C(u),\ C(v) = \frac{1}{\sqrt{2}} \quad (u,\ v = 0\ \text{の時})$$

$$= 1 \quad (u,\ v \neq 0\ \text{の時})$$

[0055] B. Adjustment of the quantization table QT by the quantization level multiplier QCx : since it is created by carrying out the multiplication of the base quantity child-ized table BQT and the quantization level multiplier QCx according to said formula 2, the quantization table QT can enlarge each quantization level in the quantization table QT, if the value of the quantization level multiplier QCx is enlarged. In case the value of the quantization level multiplier QCx compresses image data in image data compression equipment 100, an operator chooses it from two or more values (0-15) defined beforehand.
[0056] Drawing 7 is the explanatory view showing compression/expanding actuation at the time of specifying the quantization level multiplier QCx as 4. The quantization table creation section 140 and the reverse quantization table creation section 250 create the quantization table QT shown in drawing 7 (d) according to the above-mentioned formula 2. However, in this example, the maximum of quantization level is restricted to 15 and all the values of the quantization level from which the result of multiplication becomes 15 or more are compulsorily set as 15.
[0057] If linear quantization of the DCT multiplier F (u, v) of drawing 7 (a) is carried out using the quantization table QT shown in drawing 7 (d), as shown in drawing 7 (b), DC component will be 1 and the DCT multiplier QF (u, v) all whose AC components are 0 will be obtained. Thus, if the value of the quantization level multiplier QCx is enlarged, since the number of 0 in the quantized DCT multiplier QF (u, v) will increase, a data compression rate can be raised. However, since the decoded DCT multiplier FF (u, v) which is shown in drawing 7 (g) shows the DCT multiplier F (u, v) and a value which becomes and is different of the origin shown in drawing 7 (a), it is larger than the case (drawing 6) where the quantization level multiplier QCx is equal to 1. [of degradation of image quality]
[0058] By the way, since DC component of a DCT multiplier shows the average of the image data within the pixel block PB, its effect to image quality is quite large. Therefore, it is desirable to keep the quantization level for DC components the same as the value in the base quantity child-ized table BQT

irrespective of the value of the quantization level multiplier QCx. Drawing 8 is the explanatory view showing the processing in such a case, and the quantization level QT (0 0) for DC components is kept compulsory at 1. In the case of QT(0 0) =1, since DC component of the decoded DCT multiplier FF (u, v) which is shown in drawing 8 (g) is maintained at the same value as DC component of the original DCT multiplier F (u, v) shown in drawing 8 (a), degradation of image quality can be suppressed comparatively small with compressibility comparable as the case of drawing 7 . In addition, it is not necessary to necessarily set quantization level QT (0 0) for DC components to 1, and it may set up other any value.

[0059] It is also possible to choose 0 as a quantization level multiplier QCx. As shown at drawing 9 in the case of QCx=0, all the quantization level in the quantization table QT is set as 1. Since the quantized DCT multiplier QF (u, v) is the same as the original DCT multiplier F (u, v), although compressibility is small, compression/expanding can be performed by high definition.

[0060] If the above is summarized, the quantization table creation section 140 and the reverse quantization table creation section 250 have the following descriptions.

(1) Create the quantization table QT by carrying out the multiplication of the base quantity child-ized table BQT and the quantization level multiplier QCx according to a formula 2.

(2) The result of multiplication sets up equally to maximum the thing more than the maximum (= 15) of quantization level (drawing 6 - drawing 8).

(3) Keep the quantization level QT (0 0) for DC components the same as that of the value in the base quantity child-ized table BQT irrespective of the value of the quantization level multiplier QCx (drawing 8).

(4) When the quantization level multiplier QCx is 0, set all quantization level as 1 (drawing 9).

[0061] The above-mentioned operation which asks for the quantization table QT is performed by the software program in image data compression equipment 100, and it is carried out by the reverse quantization table creation section 250 which consisted of hardware of dedication in image data decompression equipment 200. About the concrete circuitry of the reverse quantization table creation section 250, it mentions later further.

[0062] In addition, in case the quantization level multiplier QCx compresses image data with image data compression equipment 100, it can specify a value which uses a keyboard 103 and a mouse 104 and is different for every pixel block PB.

[0063] C. Huffman coding and the configuration of compressed data; the Huffman coding section 130 (drawing 1) of image data compression equipment 100 consists of the DC multiplier coding section and the AC multiplier coding section. Drawing 10 (A) is the block diagram showing the function of DC multiplier coding section. the block delay section 131 and an adder 132 are shown in drawing 10 (B) -- as -- DC multiplier DCi of each pixel block PB DC multiplier DCi-1 of the pixel block PB before one difference -- **DC is computed.

[0064] the category-ized table showing the categorizing processing section 133 in drawing 11 -- following -- the difference of DC multiplier -- it asks for Category SSSS and the discernment data ID corresponding to **DC. Category SSSS -- the difference of DC multiplier -- it is the number which shows the range of **DC. two or more difference as which the discernment data ID are specified by Category SSSS -- it is data in which it is shown from the smaller one in **DC the value of what position it is.

[0065] Category SSSS is changed into the Huffman-coding word HFDC for DC multipliers in the 1 more-dimensional Huffman coding section 134 (drawing 10). Drawing 12 is the explanatory view showing an example of the Huffman-coding table HTDC used by the 1-dimensional Huffman coding section 134. In this example, the subject-copy image data f (x y) shall be expressed by the YUV signal (a luminance signal Y and two color-difference signals U and V). The Huffman-coding table for DC multipliers of U signal / V signal common use only contains the symbolic language of the category SSSS of 0-9. On the other hand, the Huffman-coding table for DC multipliers for Y signals contains the symbolic language of the category SSSS of 15-31 other than the symbolic language of the category SSSS of 0-9. the null which mentions the Huffman-coding word of SSSS=15 later -- it is shown that it is

run data. null -- run data are data in which it is shown that the pixel block PB of a uniform color continues. Moreover, the Huffman-coding word of SSSS=16-31 is a sign which shows the value of the quantization level multiplier QCx. For example, the Huffman-coding word "111110000" over SSSS=16 shows QCx=0, and the Huffman-coding word "111111111" over SSSS=31 shows QCx=15. In addition, meaning decode is possible for the Huffman-coding word of drawing 12 about all of category SSSS=1-9, and 15-31, and instant decode is possible for it.
[0066] Drawing 13 is the block diagram showing the function of AC multiplier coding section in the Huffman coding section 130. List direct [of the array F of AC multiplier (u, v) (except for u=v=0)] is first carried out to one dimension by the zigzag scan section 135. Drawing 14 is the explanatory view showing the usual route of a zigzag scan.
[0067] The value of AC multiplier by which list direct [of the judgment section 136] was carried out to one dimension judges whether it is 0. If the value of AC multiplier is 0, the run length counter 137 will change AC multiplier of continuous 0 into the zero run length NNNN. If AC multiplier is not 0, the value of the AC multiplier will be changed into Category SSSS and the discernment data ID by the categorizing section 138. Under the present circumstances, the category-ized table shown in drawing 11 is referred to.
[0068] The zero run length NNNN and Category SSSS are changed into the Huffman-coding word HFAC for AC multipliers in the two-dimensional Huffman coding section 139. Drawing 15 is the explanatory view showing the two-dimensional Huffman-coding table HTAC for AC multipliers. Moreover, drawing 16 shows an example of the Huffman-coding word of the parts (topmost part of two lines in drawing 15) of NNNN=0 and NNNN=1 in the Huffman-coding table HTAC. In addition, the Huffman-coding word "11111" of NNNN/SSSS=0/0 shows termination of the code data to one pixel block.
[0069] Drawing 17 is the explanatory view showing an example of Huffman coding. Drawing 17 (B) shows coding of DC multiplier. When the value of DC multiplier in the pixel block before one is assumed to be 0, it is **DC=F(0 0) =12. According to the category-ized table of drawing 11 , the category SSSS of **DC=12 is 4 and the discernment data ID are "1100." Moreover, according to the Huffman-coding table for DC multipliers of drawing 12 , the Huffman-coding word HFDC of category SSSS=4 is "011." In addition, the Huffman-coding table for Y signals is used here. Huffman coding (HF+ID) to DC multiplier is set to "0111100" as shown in drawing 17 (B).
[0070] Drawing 17 (C) shows coding of AC multiplier. First, AC multiplier is put in order by the array of a single dimension with a zigzag scan. This array is changed into the category SSSS of the value which are not the zero run length NNNN and zero (refer to drawing 11). The combination of the zero run length NNNN and Category SSSS is changed into the Huffman-coding word HFAC by the Huffman-coding table for AC multipliers shown in drawing 15 and drawing 16 , and it is combined with the discernment data ID of AC multiplier which is not zero, and as shown in drawing 17 (C), Huffman coding (HFAC+ID) is created.
[0071] Drawing 18 is the explanatory view showing the configuration of compressed data. The whole compressed data consists of a header unit, the compressed data section, and the dummy section, as shown in drawing 18 (A). The header unit has 1 byte of four data DFH, DFL, DLH, and DLL, respectively. The first two data DFH and DFL show the class of data contained in the compressed data section. There is a class of the data of the base quantity child-ized table BQT, full color natural picture compression data, run length picture compression data, etc. of the data of the compressed data section. Data (DLH+DLL) of 16 bits of posterior parts of a header show the data length of the sum total of the compressed data section and the dummy section. Since the compressed data section is variable-length data containing Huffman coding, the data length of the sum total with the dummy section is adjusted so that it may become the die length of the integral multiple of WORD (= 2 bytes).
[0072] Drawing 18 (B) shows the configuration of the compressed data showing the base quantity child-ized table BQT. This one-set compressed data contains the data showing the base quantity child-ized table BQT for Y signals, and the data showing the base quantity child-ized table BQT of U signal / V signal common use. In addition, it is not necessary to carry out Huffman coding of the data showing the

base quantity child-ized table BQT.

[0073] Drawing 18 (C) shows the configuration of the compressed data of a full color natural image. the code data (symbolic language of category SSSS=16-31 in drawing 12) which expresses the quantization level multiplier QCx to the compressed data section, the block data which is code data of each pixel block, and the null which shows two or more pixel blocks of a uniform color -- run data are included.

[0074] As shown in drawing 18 (D), the block data of one unit consists of 4 sets of data for Y signals, 1 set of U signal data, and 1 set of data for V signals. Drawing 19 is the explanatory view showing the relation of a block of each signal of YUV. As shown in drawing 19 (A), one screen in this example has the magnitude of the 256 pixel x240 scanning line. About a Y signal, DCT conversion is performed for every 8x8-pixel pixel block, without culling out. On the other hand, about U signal and V signal, as shown in drawing 19 (B), it is thinned out and (subsampling) made one half in a longitudinal direction and a lengthwise direction, and DCT conversion is performed to the 8x8-pixel block after thinning out. Therefore, as shown in drawing 19 (C), the field of four pixel blocks Y1-Y4 of a Y signal is equivalent to the field of one pixel block of U signal and V signal. In addition, it is because it is comparatively insensible to change (change of U signal and V signal) of a color to operate U signal and V signal on a curtailed schedule, without operating a Y signal on a curtailed schedule although human being's eyes are comparatively sensitive to change (change of a Y signal) of brightness. Compressibility can be raised by thinning out only U signal and V signal, without degrading image quality too much. In addition, the block data of one unit shown in drawing 18 (D) arranges in order the Huffman-coding data of each field shown in drawing 19 (C).

[0075] The code data to one pixel block in block data consists of one Huffman-coding data of DC multiplier, and two or more Huffman-coding data of AC multiplier, as shown in drawing 18 (F). The Huffman-coding data of DC multiplier consist of a Huffman-coding word HFDC of Category SSSS, and discernment data ID, as mentioned above (drawing 18 (G)). Moreover, the Huffman-coding data of AC multiplier consist of the Huffman-coding words HFAC and the discernment data ID to combination with Category SSSS with the zero run length NNNN (drawing 18 (H)).

[0076] The code data of the quantization level multiplier QCx is inserted just before the block data of the pixel block which wants to change the head of the compressed data section, and the value of the quantization level multiplier QCx. To two or more pixel blocks before the 2nd quantization level multiplier QCx is inserted, the top quantization level multiplier QCx is used in common. Moreover, to two or more blocks before the 3rd quantization level multiplier QCx (not shown) is inserted, the 2nd quantization level multiplier QCx is used in common.

[0077] In addition, when the symbolic language of the quantization level multiplier QCx is not contained at the head of the compressed data section, it is considered that it is QCx=1. Therefore, also when the quantization level multiplier QCx is not inserted in the head of the compressed data section but the quantization level multiplier QCx is inserted only once on the way, it is equivalent to two quantization level multipliers QCx being specified.

[0078] Since Huffman coding showing the quantization level multiplier QCx is inserted between block data, it can apply this new quantization level multiplier QCx easily to the next block data at the time of the new quantization level multiplier QCx being decrypted. Moreover, since the code data of the quantization level multiplier QCx is expressed with the Huffman-coding word for DC multipliers as shown in drawing 12 , even if this is inserted between block data, it is possible to judge immediately whether this code data is code data of DC multiplier for block Y1 or it is the code data of the quantization level multiplier QCx.

[0079] the null contained in the compressed data section -- run data are shown in drawing 18 (E) -- as -- null -- it consists of discernment data ID with the symbolic language for DC multipliers "NRL" which shows that it is run data, and the block count.

[0080] drawing 20 -- null -- it is the explanatory view showing the image expressed by run data. The background BG of the subject-copy image of drawing 20 (A) is applied in the uniform color. The part of the ellipse of drawing 20 (A) is assumed to be what 18 pixel blocks which have the image data value (f (x y) = 12) with all the same pixels as shown in drawing 20 (B) are following. the null to which drawing

20 (C) expresses these pixel blocks -- run data are shown. this null -- run data -- the 1st null for a 16-pixel block -- the run data NRD1 and the 2nd null for a 2-pixel block -- the run data NRD2 are included.

[0081] each -- null -- the head of the run data NRD1 and NRD2 -- null -- it has the symbolic language for DC multipliers "NRL" (symbolic language of category SSSS=15 of drawing 12 "1111011") which shows that it is run data. decrypting the symbolic language for DC multipliers in a head, since Huffman coding of DC multiplier is arranged at the head of the usual block data as shown in drawing 18 (F) -- null -- run data, block data, and the code data of the quantization level multiplier QCx -- a meaning -- and it is discriminable in an instant.

[0082] The block count is expressed with the Huffman-coding word for AC multipliers as shown in drawing 20 (C). drawing 21 -- the inside of the Huffman-coding table for AC multipliers (drawing 15) -- null -- it is drawing showing the part used for run data. null -- when used for run data, if the zero run length NNNN is equal to ([block count]-1), he will be set up. Moreover, the Huffman-coding word of category SSSS=1 is used noting that the value of AC multiplier is 1. the 1st null shown in drawing 20 (C) -- the data (NNNN/SSSS=15/1) of the block count in the run data NRD1 show that 16 pixel blocks of a uniform color are continuing. moreover, the 2nd null -- the data (NNNN/SSSS=1/1) of the block count in the run data NRD2 show that two pixel blocks of a uniform color are continuing.

[0083] each -- null -- the discernment data ID are added to the back end of the run data NRD1 and NRD2. It is fixed to ID=1 in this example.

[0084] null -- run data can express that two or more pixel blocks which continued with about 20-bit data are uniform colors in this way for the usual block data's, expressing the one-set block (the Y signal shown in drawing 19 -- a 4-pixel block, U signal, and V signal -- an every 1pixelblock -- it contains) of a uniform color on the other hand -- about 300- about 400 bits is required. And also when it is shown that a two or more sets pixel block is a uniform color, it is [about 300 - 400 bits of abbreviation] required about each set. therefore, null -- if run data are used, it is possible to reduce considerably the amount of data of the compressed data showing the pixel block of a majority of continuous uniform colors.

[0085] in addition, null -- the value of the luminance signal Y of a pixel block of a uniform color and color-difference signals U and V expressed by run data is not included in compressed data, but is specified in the software program which describes video game. He specifies the brightness and color tone of these blocks using a keyboard 103 or a mouse 104 while he specifies the range of the field (drawing 20 (A) the background BG) of a pixel block of a uniform color with a mouse 104, in case an operator creates the software program for video game. When carrying out like this and a specific event occurs while having performed the game, for example using video game equipment 20 (drawing 3), the special visual effectiveness of changing the color of Background BG in time can be produced. in addition, null -- about the concrete circuitry which decrypts run data, it mentions later further.

[0086] D. The detail configuration of the reverse quantization table creation section : drawing 22 is the block diagram showing the internal configuration of the reverse quantization table creation section 250 shown in drawing 1 . The reverse quantization table creation section 250 is equipped with the multiplication unit 254 which carries out the multiplication of the address-generation circuit 252 which generates the address of RAM251 and RAM251 which memorizes the base quantity child-ized table BQT, the latch circuit 253 holding the quantization level multiplier QCx, and the quantization level multiplier QCx and the base quantity child-ized table BQT, and generates the quantization table QT. The quantization table QT which was caused multiplication unit 254 and created is supplied to the reverse quantization section 220.

[0087] First, if the compression image data ZZ contained by CD-ROM is given to the Huffman decryption section 210, the code data of the base quantity child-ized table BQT will be decrypted first, and will be supplied to RAM251. This base quantity child-ized table BQT is memorized by RAM251 according to the light address given from the address-generation circuit 252. The base quantity child-ized table BQT memorized by RAM251 is used to all pixel blocks.

[0088] The address-generation circuit 252 generates the lead address synchronizing with the DCT multiplier data QF (u, v) outputted from the Huffman decryption section 210, and the base quantity

child-ized table BQT is read from RAM251 according to this lead address. On the other hand, the quantization level multiplier QCx decrypted in the Huffman decryption section 210 is latched by the latch circuit 253, and it is saved at a latch circuit 253 until the following quantization level multiplier QCx is given. Therefore, the same quantization level multiplier QCx is used in common to two or more pixel blocks until the quantization level multiplier QCx is newly supplied.

[0089] Drawing 23 is the block diagram showing the internal configuration of the latch circuit 253 contained in the reverse quantization table creation section 250 (drawing 22), and the multiplication unit 254. The latch circuit 253 consists of two latches 402,404. The multiplication unit 254 has the synchronous-clock creation circuit 412, AND circuit 414, U signal start detector 416, V signal start detector 418, NAND circuit 420, the selector 422, the multiplier 424, the clipping circuit 426, and the zero value correction circuit 428.

[0090] Drawing 24 is a timing chart which shows actuation of the circuit shown in drawing 23 . If the quantization level multiplier QCx is decrypted in the Huffman decryption section 210 (drawing 1), the data of the quantization level multiplier QCx will be given to a latch circuit 253 with an enable signal QEN (drawing 24 (a), (b)). The 1st latch 402 latches the quantization level multiplier QCx by the rising edge of an enable signal QEN, and supplies an output Q1 to the 2nd latch 404 (drawing 24 (c)).

[0091] As shown in drawing 24 (d), after the base quantity child-ized table BQT for Y signals is read 4 times, the base quantity child-ized table BQT of U signal / V signal common use is read twice from RAM251 (drawing 22).

[0092] Synchronizing with the base quantity child-ized table BQT read from RAM251, it is set to L level in the period of a Y signal, and block recognition signal UV/Y used as H level is given to the synchronous-clock creation circuit 412 (drawing 23) from the address-generation circuit 252 in the period of U signal and V signal (drawing 24 (e)). Moreover, an enable signal EN is also given to the synchronous-clock creation circuit 412 in this case. The synchronous-clock creation circuit 412 reverses block recognition signal UV/Y, generates a synchronizing clock signal SCK (drawing 24 (f)), and supplies this to the 2nd latch's 404 clock input terminal. The 2nd latch 404 latches the 1st latch's 402 output Q1 by the rising edge of this synchronizing clock signal SCK, and supplies that output Q2 (drawing 24 (g)) to the data input terminal of a selector 422. In addition, the fixed value "1" is given to other data input terminals of a selector 422.

[0093] U signal start detector 416 generates U start signal USTRT (drawing 24 (h)) which shows the start time of day of the base quantity child-ized table BQT for U signals based on the block recognition signals UV/Y and the 10MHz basic clock signal CLK. This U start signal USTRT is a signal set to L level from the rising edge of block recognition signal UV/Y only for 100 nanoseconds.

[0094] Six blocks Y1-Y4, and the block change signal SWTCH (drawing 24 (i)) and the block recognition signals UV/Y with which level changes by turns in each period of U and V are given to AND circuit 414. V signal start detector 418 generates V start signal VSTRT (drawing 24 (j)) which shows the start time of day of the base quantity child-ized table BQT for V signals based on the output of AND circuit 414, and the 10MHz basic clock signal CLK. Block recognition signal UV/Y of this V start signal VSTRT is the signal set to L level from the rising edge of the block change signal SWTCH only for 100 nanoseconds in the period of H level.

[0095] Drawing 25 is the block diagram showing the internal configuration of U signal start detector 416 and V signal start detector 418. These circuits 416,418 are constituted from a D flip-flop and a NAND circuit by both. The block recognition signals UV/Y are supplied to D input terminal of D flip-flop 432 of U signal start detector 416, and the 10MHz basic clock signal CLK is inputted into the clock input terminal. Block recognition signal UV/Y and the reversal output of D flip-flop 432 are given to the input terminal of NAND circuit 434. In addition, block recognition signal UV/Y synchronizes with the basic clock signal CLK.

[0096] Since the block recognition signals UV/Y is [the reversal output of D flip-flop 432] H level between L level, the output USTRT of NAND circuit 434 is maintained at H level (refer to drawing 24 (h)). If the output (U start signal USTRT) of NAND circuit 434 is set to L level and D flip-flop 432 latches an input with the edge of the basic clock signal CLK after 100 nanoseconds immediately after

block recognition signal UV/Y changes from L level to H level, the output USTRT of NAND circuit 434 will return to H level again.
[0097] Actuation of V signal start detector 418 is the same as actuation of U signal start detector 416. However, since the AND of block recognition signal UV/Y and the block change signal SWTCH is given to D input terminal of D flip-flop 436, in the period of H level, V start signal VSTRT is set to L level from the rising edge of the block change signal SWTCH by block recognition signal UV/Y only for 100 nanoseconds.
[0098] U start signal USTRT and V start signal VSTRT are inputted into NAND circuit 420 (drawing 23), and the output (selection signal SEL) is supplied to the selection input terminal of a selector 422. A selection signal SEL (drawing 24 (k)) is set to H level only for 100 nanoseconds at the beginning of the period the start of the period for U signals, and for V signals. A selector 422 outputs the output Q2 given from the latch circuit 253 as it is, when a selection signal SEL is L level, and on the other hand, when a selection signal SEL is H level, it outputs a fixed value "1." The multiplication of the output Q3 of a selector 422 is carried out to the base quantity child-ized table BQT by the multiplier 424.
[0099] As shown in drawing 24 (l), the output Q3 of a selector 422 is surely set to "1" irrespective of the value of the quantization level multiplier QCx at the beginning of the period the start of the period for U signals, and for V signals. The period for 100 nanoseconds which the period the object for U signals and for V signals begins is a period for computing the quantization level for DC multipliers. Therefore, if the circuit of drawing 23 is used, it can avoid performing substantially the multiplication of the quantization level for DC multipliers used for U signal and V signal, and the specified quantization level multiplier QCx. If it puts in another way, the circuit shown in drawing 23 will be a circuit which realizes the operation shown in drawing 8 (c) and (d).
[0100] As shown in drawing 23 , the output of a multiplier 424 is corrected by a clipping circuit 426 and the zero value correction circuit 428, and serves as the final quantization table QT. Drawing 26 is the block diagram showing the internal configuration of these two circuits 426,428.
[0101] The clipping circuit 426 consists of 4 input OR circuit 450 and eight 2 input OR circuits 452. These circuits are circuits in the case of expressing quantization level by 9 bits (the most significant bit being a sign bit). D9-D12 are inputted into 4 input OR circuit 450 4 bits of high orders except a sign bit D13 among the 14-bit data outputted from the multiplier 424 (drawing 23). The output of 4 input OR circuit 450 is given to one input terminal of eight 2 input OR circuits 452, and D1-D8 are given to the input terminal of another side 8 bits of low order of the output of a multiplier 424. When at least one value of D9-D12 is "1" 4 bits of high-orders, all of the output of eight 2 input OR circuits 452 are set to "1." Therefore, the output of a clipping circuit 426 is set to the case of 255 or more for the output of a multiplier 424 by 255 with a decimal number.
[0102] In the zero value correction circuit 428, the output of seven 2 input OR circuits 452 seven bits D2 in a clipping circuit 426 - for D8 is outputted as it is. Moreover, the output and sign bit D13 of these seven 2 input OR circuits 452 are given to eight inverters 460, respectively. The output of eight inverters 460 is given to 8 input AND circuit 462, and the output of this AND circuit 462 is supplied to 2 input OR circuit 464. The output of 2 input OR circuit 452 for least significant bit D1 is given to this 2 input OR circuit 464. Consequently, when [of the output of a multiplier 424] all of 13 bits of values of D1-D13 are "0", as for the zero value correction circuit 428, the value of 8 bits of others [value / of the least significant bit] outputs the quantization level QT of "0" by "1." If it puts in another way, the zero value correction circuit 420 will have realized the operation shown in drawing 9 (c) and (d).
[0103] E. null -- decryption [of run data]: -- drawing 27 is the block diagram showing the internal configuration of the Huffman decryption section 210 (drawing 1) in image data decompression equipment 200. The Huffman decryption section 210 is equipped with the decryption section 470 which carries out the Huffman decryption of the compression image data ZZ, the control section 472, the selector 474, and DC multiplier register 476.
[0104] the class of compressed data with which the decryption section 470 was given -- the base quantity child-ized table BQT, the quantization level multiplier QCx, block data, and null -- it judges any of run data they are, and the condition signal SS which shows the class of compressed data is

supplied to a control section 472. A control section 472 supplies control signals CTL1, CTL2, and CTL3 to the decryption section 470, a selector 474, and MPU40 (drawing 3) of video game equipment according to this condition signal SS, respectively. The base quantity child-ized table BQT and the quantization level multiplier QCx which were decrypted are supplied to the reverse quantization table creation section 250 from the decryption section 470. The DCT multiplier QF (u, v) which quantized after decode is supplied to a selector 474 from the decryption section 470.

[0105] The DC multiplier QF (0 0) registered into the zero data and DC multiplier register 476 other than the DCT multiplier QF (u, v) given from the decryption section 470 is given to the data input terminal of a selector 474. The value of the DC multiplier QF (0 0) of a pixel block of the uniform color described in the software program of a game is written in DC multiplier register 476 by MPU40 of video game equipment. In addition, the value from which the DC multiplier QF (0 0) differs to a YUV signal, respectively is registered.

[0106] two null shown in drawing 20 (C) here -- the case where the run data NRD1 and NRD2 are decrypted is considered. the 1st null -- if the data NRL of the head of the run data NRD1 are detected by the decryption section 470 -- null -- the condition signal SS which tells that it is run data is outputted to a control section 472 from the decryption section 470. A control section 472 is controlled to output control signals CTL1 and CTL2 to the decryption section 470 and MPU40 immediately according to the condition signal SS, respectively, and to stop decryption actuation. Moreover, a control section 472 supplies a control signal CTL3 to a selector 474, and makes the DC multiplier QF (0 0) registered into DC multiplier register 476 choose as a DC multiplier of the first block. As shown in drawing 20 (B), when the value of the subject-copy image data f (x y) is 12, QF(0 0) =12 are registered into DC multiplier register 476. A control section 472 controls a selector 474 as an AC multiplier of 63 pieces further to choose zero data altogether. Drawing 28 shows the DCT multiplier QF (u, v) created in this way.

[0107] the 1st null -- since the run data NRD1 show that 16 blocks of a uniform color are continuing, the DCT multiplier QF (u, v) shown in drawing 28 is created about each of 16 pixel blocks. the 2nd null -- the DCT multiplier QF (u, v) shown in drawing 28 is similarly created [each / of two blocks] about the run data NRD2.

[0108] null -- after processing of run data is completed, a control section 472 outputs control signals CTL1 and CTL2 to the decryption section 470 and MPU40, and it controls to resume decryption actuation. null -- the value of the luminance signal Y of a pixel block and color-difference signals U and V as which it is specified that it is a uniform color can be easily changed with run data by changing the value of DC multiplier written in DC multiplier register 476 from MPU40. if it puts in another way -- null -- if run data are used, the color of the image field of a uniform color can be changed into a desired color according to data other than compression image data. In this example, the value of the luminance signal Y of a block of a uniform color and color-difference signals U and V is specified in the software program which describes video game.

[0109] Drawing 29 is the block diagram showing other configurations of the Huffman decryption section. In this Huffman decryption section 210a, the DCT multiplier QF (u, v) outputted from the decryption section 470 bypasses a selector 474, and is directly given to the reverse quantization section 220. A selector 474 chooses one side of the DC multiplier QF (0 0) given from DC multiplier register 476, and zero data, bypasses the reverse quantization section 220, and supplies it to the IDCT section 230 directly. The control section 478 is outputting the 4th control signal CTL4 other than the three same control signals CTL1-CTL3 as drawing 27 to the IDCT section 230.

[0110] A control section 478 outputs control signals CTRL1, CTL2, and CTL4 to the decryption section 470, MPU40, and the IDCT section 230 according to the condition signal SS which shows the class of compressed data, respectively. Decode of the block data usual in the decryption section 470 supplies the decrypted DCT multiplier QF (u, v) to the reverse quantization section 220.

[0111] the 1st null shown in drawing 20 (C) -- if the data NRL of the head of the run data NDR 1 are detected by the decryption section 470 -- null -- the condition signal SS which tells that it is run data is outputted to a control section 478 from the decryption section 470. A control section 478 is controlled to

output control signals CTL1 and CTL2 to the decryption section 470 and MPU40 immediately according to the condition signal SS, respectively, and to stop decryption actuation. Moreover, a control section 478 switches the level of the control signal CTL3 given to a selector 474, and makes the DC multiplier QF (0 0) registered into DC multiplier register 476 choose. A control section 478 controls a selector 474 as an AC multiplier of 63 pieces further to choose zero data altogether. A control section 478 outputs a control signal CTL4 to coincidence to the IDCT section 230, and controls it to choose and carry out inverse transformation of the output of a selector 474.
[0112] null -- after processing of run data is completed, control signals CTL1 and CTL2 are outputted to the decryption section 470 and MPU40 from a control section 478, and it controls to resume decode actuation.
[0113] thus -- the circuit shown in drawing 29 -- null -- in the case of processing of run data, since the DCT multiplier QF (u, v) outputted from a selector 474 bypasses the reverse quantization section 220 and is directly supplied to the IDCT section 230, there is an advantage that the operation error by reverse quantization does not arise. For example, since the operation error by quantization is pressed down by min when the video encoder unit 50 (drawing 3) performs chroma-key processing which detects the part of a specific color and is made into a transparent plane color, it is possible to make the pixel block of a desired color into a transparent plane color certainly.
[0114] the above-mentioned example -- setting -- null -- although it enabled it to set only DC multiplier as arbitration with run data, it is also possible to enable it to set up a desired value to the predetermined part (for example, QF (1 0) and QF (0 1)) of AC multiplier. in this case, null -- run data express the number of a series of pixel blocks which has the same image pattern.
[0115] F. modification: -- the range which this invention is not restricted to the above-mentioned example, and does not deviate from that summary in addition -- setting -- various voice -- it is possible to set like and to carry out, for example, the following deformation is also possible.
[0116] (1) Although two-dimensional DCT conversion was taken up as orthogonal transformation in the above-mentioned example, to this invention, the orthogonal transformation (for example, K-L conversion and a Hadamard transform) of arbitration is available. Moreover, as entropy code modulation, coding (for example, algebraic-sign-izing and MEL coding) of arbitration other than Huffman coding can be used.
[0117] (2) You may realize by hardware and image data compression equipment 100 may realize image data decompression equipment 200 by software. Drawing 30 is a flow chart which shows the procedure of the processing which elongates the compressed data shown in drawing 18 with software. At step S1, the contents of compressed data are judged from the value of a header unit. When compressed data expresses the base quantity child-ized table BQT, in step S2, the base quantity child-ized table BQT is memorized in memory, and it returns to step S1.
[0118] When compressed data expresses the image, the class of initial data of each data unit contained in compressed data circles in step S3 is judged. the code data of the quantization level multiplier QCx indicated to be a data unit to drawing 18 (C) here, block data, and null -- each of run data is meant. the Huffman-coding word which expresses the quantization level multiplier QCx as initial data of a data unit as shown in drawing 18 (C), (D), (E), and (F), the Huffman-coding word of DC multiplier **DC of block data, and null -- there are three kinds of the Huffman-coding words NRL showing a run.
[0119] When initial data are the Huffman-coding words of the quantization level multiplier QCx, in step S4, the quantization table QT is created by multiplying by this quantization level multiplier QCx and the base quantity child-ized table BQT. In addition, when the value of that the description mentioned above on the occasion of this multiplication, i.e., (1) multiplication result, sets the quantization level more than maximum as maximum, not quantizing (2) DC multiplier, and (3) quantization level multiplier QCx is 0, setting-as 1-all quantization level ** is realized. If the quantization table QT is created in step S4, it will return to step S3.
[0120] When it is judged that initial data are the Huffman-coding words of DC multiplier **DC in step S3, the data for a 1-pixel block are decrypted in step S5, and the DCT multiplier QF (u, v) is obtained. Reverse quantization is performed at step S6, and two-dimensional DCT inverse transformation is

performed at step S7. If processing of steps S5-S7 is repeated about all pixel blocks included in one-set block data (drawing 18 (D)), it will return from step S8 to step S3.
[0121] step S3 -- setting -- initial data -- null -- when it is judged that it is the Huffman-coding word NRL which shows that it is run data, while DC component of a 1-pixel block is set as the value specified beforehand in step S9, all of 63 AC components are set as 0. At step S10, two-dimensional DCT inverse transformation is performed to the DCT multiplier created in this way. null -- only the block count specified by run data will return from step S11 to step S3, if step S9 and processing of S10 are repeated. In this way, image data ff (x y) is restored by covering all the compressed data sections and performing processing of steps S3-S11.
[0122] (3) Although the above-mentioned example showed the example which applied this invention to video game equipment, this invention can be applied to all kinds of image processing system.
[0123] (4) Although the quantization level multiplier QCx and each quantization level in the quantization table QT were made into the integer in the above-mentioned example, a number including a decimal is sufficient as these.
[0124]
[Effect of the Invention] Since the 1st and 2nd quantization table on which quantization level differs can be created only by giving the 1st and the 2nd multiplier according to invention indicated to claims 1, 12, and 23 as explained above, it is effective in the ability to reduce the amount of data of compression image data compared with the case where two quantization tables are included in compression image data.
[0125] according to claims 2, 13, and 24 and invention boiled and indicated, it is effective in matching the 1st and the 2nd multiplier with the 1st and 2nd pixel block easily, respectively.
[0126] according to invention indicated to claims 3, 14, and 25 -- the 1st and the 2nd multiplier -- a meaning -- and it is effective in the ability to decode in an instant.
[0127] Since the 1st multiplier is applied to two or more pixel blocks until the 2nd multiplier appears according to invention indicated to claims 4 and 15, it is not necessary to include the 1st multiplier before each code data of a pixel block of these plurality, therefore is effective in the ability to reduce the amount of data of compression image data.
[0128] According to invention indicated to claims 5 and 16, it is effective in the ability to maintain the number of bits of quantization level below at constant value.
[0129] According to invention indicated to claims 6 and 17, it is effective in the ability to reduce the error generated in case the transform coefficient of a position is reverse-quantized.
[0130] If it is made not to change the quantization level to the dc component of a transform coefficient according to invention indicated to claims 7 and 18, it is effective in the ability to reduce the error accompanying reverse quantization of a dc component.
[0131] According to invention indicated to claims 8 and 19, it is effective in the ability of comparatively little data to express two or more continuous pixel blocks which have the same image pattern of each other.
[0132] According to invention indicated to claims 9 and 20, it is effective in the ability to apply two or more continuous pixel blocks in the same color.
[0133] According to invention indicated to claims 10 and 21, it is effective in the ability to prevent generating of the error by reverse quantization.
[0134] According to invention indicated to claim 11, it is effective in the ability of comparatively little data to express two or more continuous pixel blocks which have the color of the same pattern mutually.
[0135] According to invention indicated to claim 26, it is effective in the ability of comparatively little data to express two or more continuous pixel blocks which have the same image pattern of each other.
[0136] Since what is necessary is according to invention indicated to claim 27 just to include the 1st multiplier code in compression image data when using a new quantization table to at least one pixel block including the 1st pixel block, it is effective in the ability to reduce the amount of data of compression image data.
[0137] Since the 1st and 2nd quantization table on which quantization level differs can be created only

by giving the 1st and the 2nd multiplier according to invention indicated to claim 28, it is effective in the ability to reduce the amount of data of compression image data compared with the case where two quantization tables are included in compression image data.
[0138] Moreover, according to invention indicated to claim 29, it is effective in matching the 1st and the 2nd multiplier with the 1st and 2nd pixel block easily, respectively.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Industrial Application] This invention relates to the approach of compressing and elongating image data, and the equipment for it.

[Translation done.]

PRIOR ART

[Description of the Prior Art] Drawing 31 is the block diagram showing the configuration of compression/expanding equipment of the conventional image data. After it carries out orthogonal transformation of the subject-copy image data for every block of a MxN pixel in the orthogonal transformation section 542, image data compression equipment 540 quantizes in the quantization section 544, further, encodes in the entropy-code-modulation section 546, and creates compression image data. On the other hand, image data decompression equipment 550 restores image data by the reverse orthogonal transformation section 552, after decrypting compression image data in the entropy decryption section 556 first and reverse-quantizing in the reverse quantization section 554. In addition, the quantization section 544 and the reverse quantization section 554 use the same quantization table 562, and use the same sign table 564 also for the entropy-code-modulation section 546 and the entropy decryption section 556.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] Since the 1st and 2nd quantization table on which quantization level differs can be created only by giving the 1st and the 2nd multiplier according to invention indicated to claims 1, 12, and 23 as explained above, it is effective in the ability to reduce the amount of data of compression image data compared with the case where two quantization tables are included in compression image data.
[0125] according to claims 2, 13, and 24 and invention boiled and indicated, it is effective in matching the 1st and the 2nd multiplier with the 1st and 2nd pixel block easily, respectively.
[0126] according to invention indicated to claims 3, 14, and 25 -- the 1st and the 2nd multiplier -- a meaning -- and it is effective in the ability to decode in an instant.
[0127] Since the 1st multiplier is applied to two or more pixel blocks until the 2nd multiplier appears according to invention indicated to claims 4 and 15, it is not necessary to include the 1st multiplier before each code data of a pixel block of these plurality, therefore is effective in the ability to reduce the amount of data of compression image data.
[0128] According to invention indicated to claims 5 and 16, it is effective in the ability to maintain the number of bits of quantization level below at constant value.
[0129] According to invention indicated to claims 6 and 17, it is effective in the ability to reduce the error generated in case the transform coefficient of a position is reverse-quantized.
[0130] If it is made not to change the quantization level to the dc component of a transform coefficient according to invention indicated to claims 7 and 18, it is effective in the ability to reduce the error accompanying reverse quantization of a dc component.
[0131] According to invention indicated to claims 8 and 19, it is effective in the ability of comparatively little data to express two or more continuous pixel blocks which have the same image pattern of each other.
[0132] According to invention indicated to claims 9 and 20, it is effective in the ability to apply two or more continuous pixel blocks in the same color.
[0133] According to invention indicated to claims 10 and 21, it is effective in the ability to prevent generating of the error by reverse quantization.
[0134] According to invention indicated to claim 11, it is effective in the ability of comparatively little data to express two or more continuous pixel blocks which have the color of the same pattern mutually.
[0135] According to invention indicated to claim 26, it is effective in the ability of comparatively little data to express two or more continuous pixel blocks which have the same image pattern of each other.
[0136] Since what is necessary is according to invention indicated to claim 27 just to include the 1st multiplier code in compression image data when using a new quantization table to at least one pixel block including the 1st pixel block, it is effective in the ability to reduce the amount of data of compression image data.
[0137] Since the 1st and 2nd quantization table on which quantization level differs can be created only by giving the 1st and the 2nd multiplier according to invention indicated to claim 28, it is effective in the ability to reduce the amount of data of compression image data compared with the case where two

quantization tables are included in compression image data.

[0138] Moreover, according to invention indicated to claim 29, it is effective in matching the 1st and the 2nd multiplier with the 1st and 2nd pixel block easily, respectively.

[Translation done.]

* NOTICES *

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, the 1st part to restore by high definition in one image and the 2nd part which may be restored by low image quality may be included. In such a case, what is necessary is to quantize using the small quantization table of quantization level to the 1st part, and just to quantize using the big quantization table of quantization level to the 2nd part. A quantization table is the matrix of the same size as the pixel block of image data, i.e., the matrix of a M line N train. With the conventional image data compression / expanding equipment, when two or more quantization tables were used in one image, two or more quantization tables of a M line N train had to be transmitted to expanding equipment 550 from the compression equipment 540, and there was a problem of increasing the amount of data of compression image data.
[0004] Moreover, entropy code modulation of all the orthogonal transformation multipliers of the M line N train over those pixel blocks is carried out also with a simple image part in which the pixel block which has a uniform color continues into an image. Therefore, the compression image data showing such a simple image part also had the problem of becoming the remarkable amount of data.
[0005] This invention is made in order to solve the above-mentioned technical problem in the conventional technique, and it aims at offering the technique in which the amount of data of compression image data can be reduced compared with the former.

[Translation done.]

OPERATION

[Means for Solving the Problem and its Function] In order to solve an above-mentioned technical problem, the compression image data decompression approach by this invention (A) The code data to two or more pixel blocks, and the 1st [to the 1st pixel block located in the head of said pixel blocks of two or more] multiplier code, While generating the process for which the compression image data containing the 2nd [to the 2nd pixel block of arbitration] multiplier code is prepared, and the transform coefficient quantized by carrying out the entropy decryption of the (B) aforementioned code data the process which generates the 1st and the 2nd multiplier by carrying out the entropy decryption of said 1st and 2nd multiplier code, and (C) -- said the 1st and 2nd multiplier -- respectively -- ** -- by multiplying by the base quantity child-ized level of a predetermined base quantity child-ized table While reverse-quantizing the 1st, the process which creates the 2nd quantization table, and said quantized transform coefficient to the pixel block of the (D) above 1st on said 1st quantization table By reverse-quantizing said quantized transform coefficient to said 2nd pixel block on said 2nd quantization table It has the process which asks for the elongated image data by carrying out reverse orthogonal transformation of the transform coefficient by which the (E) aforementioned reverse quantization was carried out to the process which asks for the reverse-quantized transform coefficient.
[0007] Since the 1st and 2nd quantization table on which quantization level differs can be created only by giving the 1st and the 2nd multiplier, compared with the case where two quantization tables are included in compression image data, the amount of data of compression image data can be reduced.
[0008] While said code data contains two or more data units arranged according to the array sequence of a pixel block of said plurality, said 1st multiplier code is arranged just before the 1st [to said 1st pixel block] data unit, and said 2nd multiplier code may be made to be arranged just before the 2nd [to said 2nd pixel block] data unit.
[0009] If it carries out like this, the 1st and the 2nd multiplier are easily matched with the 1st and 2nd pixel block, respectively.
[0010] Moreover, as for said 1st and 2nd multiplier code, it is desirable that it is an entropy symbolic language in the sign table containing two or more entropy symbolic languages which receive the dc component of said the 1st, 2nd multiplier, and said transform coefficient.
[0011] if it carries out like this -- the 1st and the 2nd multiplier -- a meaning -- and it can decode in an instant.
[0012] As for said process (D), it is desirable to make it include the process reverse-quantized using said 1st quantization table to a series of pixel blocks from said 1st pixel block to the 3rd pixel block arranged just before said 2nd pixel block.
[0013] Since the 1st multiplier is applied to two or more pixel blocks until the 2nd multiplier appears, it is not necessary to include the 1st multiplier before each code data of a pixel block of these plurality.
[0014] When the multiplication result of said the 1st and each of the 2nd multiplier, and the quantization level contained in said base quantity child-ized table exceeds predetermined maximum, you may make it said process (C) include the process which sets up equally to said maximum the value of the quantization level for which said multiplication result exceeded said maximum.

[0015] If it carries out like this, the number of bits of quantization level can be maintained below at constant value.
[0016] You may make it said process (C) include the process made into the quantization level of said 1st and 2nd reverse quantization table as it is about the predetermined base quantity child-ized level in said base quantity child-ized table, without performing said multiplication substantially.
[0017] If it carries out like this, the error generated in case the transform coefficient of a position is reverse-quantized can be reduced.
[0018] Said predetermined base quantity child-ized level has [making it be the quantization level about the dc component of said transform coefficient] a desirable thing.
[0019] If it is made not to change the quantization level to the dc component of a transform coefficient, the error accompanying reverse quantization of a dc component can be reduced.
[0020] Said compression image data contains the same pattern block data which shows the number of two or more continuous pixel blocks which has the still more nearly same image pattern. Further said process (B) In case said quantized transform coefficient to said two or more pixel blocks expressed with said same pattern block data is created, while setting the predetermined component of said transform coefficient as the value specified beforehand You may make it have the process created by setting the value of the component of said transform coefficients other than said predetermined component as zero.
[0021] If it carries out like this, comparatively little data can express two or more continuous pixel blocks which have the same image pattern of each other.
[0022] As for said predetermined component, it is desirable that it is a dc component.
[0023] If it carries out like this, two or more continuous pixel blocks can be applied in the same color.
[0024] You may make it said process (D) include the process which omits said reverse quantization about said transform coefficient decrypted from said same pattern block data.
[0025] If it carries out like this, generating of the error by reverse quantization can be prevented.
[0026] Other compression image data decompression approaches by this invention (A) The process for which the compression image data containing the code data to two or more 1st pixel blocks and the same pattern block data which shows the number of two or more 2nd continuous pixel blocks which has the same image pattern is prepared, (B) While creating the transform coefficient by which the 1st to said two or more 1st pixel blocks was quantized by carrying out the entropy decryption of said code data In case the transform coefficient by which the 2nd to said two or more 2nd pixel blocks expressed with said same pattern block data was quantized is created, while setting the predetermined component of said transform coefficient as the value specified beforehand The process which creates said transform coefficient by which the 2nd was quantized by setting the value of the component of said transform coefficients other than said predetermined component as zero, (C) by reverse-quantizing using a quantization table, said transform coefficient by which the 1st and the 2nd were quantized It has the process which creates the elongated image data the 1st, the process which asks for the transform coefficient by which the 2nd was reverse-quantized, and by carrying out reverse orthogonal transformation of the transform coefficient by which the 2nd was reverse-quantized to the (D) above 1st.

[0027] Comparatively little data can express two or more continuous pixel blocks which have the color of the same pattern mutually by this approach.
[0028] Code data [as opposed to two or more pixel blocks in the compression image data decompression equipment by this invention], The 1st [to the 1st pixel block located in the head of a pixel block of said plurality] multiplier code, While generating the transform coefficient quantized a storage means to memorize the compression image data containing the 2nd [to the 2nd pixel block of arbitration] multiplier code, and by carrying out the entropy decryption of said code data An entropy decryption means to generate the 1st and the 2nd multiplier by carrying out the entropy decryption of said 1st and 2nd multiplier code, By multiplying by said the 1st and each of the 2nd multiplier, and the base quantity child-ized level of a predetermined base quantity child-ized table While reverse-quantizing said quantized transform coefficient to the 1st, a reverse quantization table creation means to create the 2nd quantization table, and said 1st pixel block, on said 1st quantization table By reverse-quantizing said

quantized transform coefficient to said 2nd pixel block on said 2nd quantization table It has a reverse quantization means to ask for the reverse-quantized transform coefficient, and a reverse orthogonal transformation means to ask for the image data elongated by carrying out reverse orthogonal transformation of said transform coefficient by which reverse quantization was carried out.
[0029] Moreover, other compression image data decompression equipments by this invention The 1st storage means which memorizes the compression image data containing the code data to two or more 1st pixel blocks, and the same pattern block data which shows the number of the 2nd continuous pixel block of plurality which has the same image pattern, The 2nd storage means which memorizes the assignment value over the predetermined component of the transform coefficient about said two or more 2nd pixel blocks, While creating the transform coefficient by which the 1st to said two or more 1st pixel blocks was quantized by carrying out the entropy decryption of said code data In case the transform coefficient by which the 2nd to said two or more 2nd pixel blocks expressed with said same pattern block data was quantized is created An entropy decryption means to create the transform coefficient by which the 2nd was quantized by setting the value of said transform coefficients other than said predetermined component as zero while setting said predetermined component as the assignment value memorized by said 2nd storage means, By reverse-quantizing using a quantization table, said transform coefficient by which the 1st and the 2nd were quantized It has a reverse orthogonal transformation means to create the elongated image data, the 1st, a reverse quantization means to ask for the transform coefficient by which the 2nd was reverse-quantized, and by carrying out reverse orthogonal transformation of the transform coefficient by which the 2nd was reverse-quantized to said 1st [the].
[0030] The process which the compression approach of the image data based on this invention carries out orthogonal transformation of the (A) image data for two or more pixel blocks of every in an image, and asks for a transform coefficient, (B) The 1st multiplier to the 1st pixel block located in the head of said pixel blocks of two or more, the process which specifies the 2nd multiplier to the 2nd pixel block of arbitration, and (C) -- said the 1st and 2nd multiplier -- respectively -- ** -- by multiplying by the base quantity child-ized level of a predetermined base quantity child-ized table The 1st, the process which creates the 2nd quantization table, and by quantizing said transform coefficient to the (D) above 1st and the 2nd pixel block on said 1st and 2nd quantization table, respectively While creating code data by carrying out entropy code modulation of the transform coefficient by which the (E) aforementioned quantization was carried out to the process which asks for the quantized transform coefficient It has the process which creates the compression image data containing the 1st, the process which creates the 2nd multiplier code, and the (F) aforementioned code data, said 1st [the] and the 2nd multiplier code by carrying out entropy code modulation of said the 1st and 2nd multiplier.
[0031] Since the 1st and 2nd quantization table on which quantization level differs can be created only by giving the 1st and the 2nd multiplier, compared with the case where two quantization tables are included in compression image data, the amount of data of compression image data can be reduced.
[0032] The approach of elongating other compression image data to the pan by this invention (A) The process for which the compression image data containing the code data to two or more pixel blocks and the 1st [to the 1st pixel block of the arbitration of said two or more pixel blocks] multiplier code is prepared, (B) While generating the transform coefficient quantized by carrying out the entropy decryption of said code data By multiplying by the process which generates the 1st multiplier by carrying out the entropy decryption of said 1st multiplier code, the 1st multiplier of (C) above, and the base quantity child-ized level of a predetermined base quantity child-ized table By reverse-quantizing the process which creates the 1st quantization table, and said quantized transform coefficient to at least one pixel block including the pixel block of the (D) above 1st on said 1st quantization table It has the process which asks for the elongated image data by carrying out reverse orthogonal transformation of the transform coefficient by which the (E) aforementioned reverse quantization was carried out to the process which asks for the reverse-quantized transform coefficient.
[0033] [0034] which can reduce the amount of data of compression image data compared with the case where two quantization tables are included in compression image data since the 1st and 2nd quantization table on which quantization level differs can be created only by giving the 1st and the 2nd multiplier, if

it carries out like this Said compression image data contains further the 2nd [to the 2nd pixel block arranged after said 1st pixel block] multiplier code. Said process (B) The process which generates the 2nd multiplier by carrying out the entropy decryption of said 2nd multiplier code is included. Said process (C) The process which creates the 2nd quantization table by multiplying by said 2nd multiplier and the base quantity child-ized level of said base quantity child-ized table is included. Said process (D) While reverse-quantizing using said 1st quantization table, said quantized transform coefficient to a series of pixel blocks to the 3rd pixel block arranged from said 1st pixel block just before said 2nd pixel block It is desirable to make it include the process which reverse-quantizes said quantized transform coefficient to at least one pixel block including said 2nd pixel block on said 2nd quantization table.
[0035] If it carries out like this, it can quantize by using two quantization tables at the time of expanding of compression image data only by including the 1st and 2nd multiplier code in compression image data.

[Translation done.]

EXAMPLE

[Example] Below, sequential explanation is performed about each following item.
A. The whole compression/expanding equipment configuration and basic actuation;
B. Adjustment of the quantization table QT by the quantization level multiplier QCx;
C. Huffman coding and configuration of compressed data;
D. Detail configuration of the reverse quantization table creation section;
E. null -- a decryption [0037] of run data A. The configuration and actuation of compression/expanding equipment : drawing 1 is the block diagram showing the function of the compression equipment 100 of image data, and expanding equipment 200 which applied one example of this invention.
[0038] Image data compression equipment 100 is equipped with the DCT section 110 which performs discrete cosine conversion to the subject-copy image data f (x y), the quantization section 120 which quantizes the transform coefficient F (u, v) obtained by DCT conversion, the Huffman coding section 130 which carries out Huffman coding of the quantized transform coefficient QF (u, v), and creates the compression image data ZZ, the quantization table creation section 140, and the Huffman-coding table memory 150. The quantization table creation section 140 creates the quantization table QT based on the base quantity child-ized table BQT and the quantization level multiplier QCx so that it may mention later. The compression image data ZZ is memorized by storages, such as CD-ROM, and is supplied to image data decompression equipment 200 from image data compression equipment 100.
[0039] Image data decompression equipment 200 is equipped with the Huffman decryption section 210 which carries out the Huffman decryption of the compression image data ZZ, the reverse quantization section 220 which reverse-quantizes the transform coefficient QF (u, v) after the decoded quantization, the IDCT section 230 which performs discrete cosine inverse transformation to the reverse-quantized transform coefficient FF (u, v), and obtains image data ff (x y), the Huffman-coding table memory 240, and the reverse quantization table creation section 250. The reverse quantization table creation section 250 creates the quantization table QT for the base quantity child-ized table BQT and the quantization level multiplier QCx which were decoded from the compression image data ZZ based on a receipt and these from the Huffman decryption section 210. This quantization table QT is the same as the quantization table QT used with the compression equipment 100. Moreover, the Huffman-coding table HT memorized by the Huffman-coding table memory 240 is the same as what is memorized by the Huffman-coding table memory 150 of a compression equipment 100.
[0040] Drawing 2 is the block diagram showing the concrete configuration of image data compression equipment 100. This image data compression equipment 100 is equipped with CPU101, main memory 102, a keyboard 103, a mouse 104, a magnetic disk drive 105, and optical-magnetic disc equipment 106. Each processing sections 110-140 of the image data compression equipment 100 shown in drawing 1 are realized by the software program memorized by main memory 102. Moreover, the base quantity child-ized table BQT and the Huffman-coding table HT are memorized by the magnetic disk drive 105. This image data compression equipment 100 is a workstation for creating video game, and various kinds of programs for creating the video game other than the software program for image data compression are performed by CPU101. The completed game program is stored in optical-magnetic disc equipment 106

with compression image data. And CD-ROM containing the program and compression image data of video game is manufactured using this magneto-optic disk.

[0041] Drawing 3 is the block diagram showing the configuration of the video game equipment 20 containing image data decompression equipment 200. The microprocessor 40 which manages in generalization all processings about others, an image processing, and this (henceforth MPU), [CD-ROM drive / 32 / to which this video game equipment 20 was connected through the SCSI bus 36] The main memory 41 by which direct continuation was carried out to this MPU40 (it is hereafter called M-RAM), The various units connected to the bus (M-BUS) 43 of ROM42 and MPU40 which similarly memorized the BIOS program, That is, it has the picture signal control unit 45, the image data decompression unit 200, the VDP unit 49 that outputs a specific picture signal, the video encoder unit 50 which performs composition and the output of a video signal, and the voice data output unit 52 treating voice data.

[0042] Moreover, the memory connected to the local bus (K-BUS) 54 of the picture signal control unit 45 into this video game equipment 20 The memory connected to the local bus of 55 and the image data decompression unit 200 (It is hereafter called K-RAM) The video memory connected to the local bus of 251 and the VDP unit 49 (It is hereafter called R-RAM) (It is hereafter referred to as V=RAM) The output signal from 59 and the video encoder unit 50 is changed into the usual video signal (NTSC), and it has the NTSC converter 60 outputted to color television 28.

[0043] The picture signal control unit 45, the image data decompression unit 200, the video encoder unit 50, and the voice data output unit 52 are constituted by the logical circuit, respectively.

[0044] Drawing 4 (A) is the top view showing an example of the subject-copy image used as the background image of a game. This subject-copy image is an image with which volcanic natural drawing was inserted in the background BG applied in the uniform color. Drawing 4 (B) expands and shows some subject-copy images including one pixel block PB. Generally, the pixel block PB can be set up so that the pixel PX of a MxN individual may be included. As a value of two integers M and N, 8 or 16 are desirable and is M=N=8 in this example. In addition, integers M and N may be set as a different value. The amount of [which expresses Background BG in the compression image data ZZ] data division have a special data format (null run data) showing that the pixel block PB of a uniform color continues so that it may mention later.

[0045] The DCT section 110 of image data compression equipment 100 performs two-dimensional DCT conversion for every pixel block PB according to the following formula 1.

[Equation 1]

$$F(u,v) = \frac{1}{4} C(u)C(v) \sum_{x=0}^{7} \sum_{y=0}^{7} f(x,y) \cos\frac{\pi(2x+1)u}{16} \cos\frac{\pi(2y+1)v}{16}$$

$$C(u),\ C(v) = \frac{1}{\sqrt{2}} \quad (u,\ v = 0\ \text{の時})$$

$$= 1 \quad (u,\ v \neq 0\ \text{の時})$$

Here, the array of a transform coefficient, and u and v of the coordinate and F (u, v) the array of 8x8 image data by which f (x y) is contained in one pixel block PB, x, and y indicate the location of each pixel within each pixel block PB to be are the coordinates of frequency space.

[0046] Drawing 5 is the explanatory view showing the array of a transform coefficient F (u, v). A transform coefficient F (u, v) is the same array of 8x8 as the pixel block PB. The transform coefficient F of an upper left edge (0 0) is called DC component (or DC multiplier), and other transform coefficients are called AC component (or AC multiplier). DC component shows the average of the image data in the pixel block PB. Moreover, AC component shows change of the image data within the pixel block PB. Since the image data of the adjoining pixel has a certain amount of correlation, the value of a low-frequency component is comparatively large in AC multiplier, and the value of a high frequency component is comparatively small. Moreover, the effect which it has on image quality has a comparatively small high frequency component.

[0047] Drawing 6 is the explanatory view showing basic actuation of image data compression equipment 100 and image data decompression equipment 200. The DCT section 110 creates the DCT multiplier F (u, v) shown in drawing 6 (a).

[0048] The quantization table creation section 140 creates the quantization table QT (drawing 6 (d)) by multiplying by the base quantity child-ized table BQT (drawing 6 (c)) and the quantization level multiplier QCx, as shown in the following formula 2.

[Equation 2]

$$QT\ (u,\ v) = QCx \times BQT\ (u,\ v)$$

[0049] Since it is QCx=1 in the example of drawing 6 , the quantization table QT is the same as the base quantity child-ized table BQT.

[0050] The quantization section 120 asks for the quantized DCT multiplier QF (u, v) which is shown in drawing 6 (b) by carrying out linear quantization of the DCT multiplier F (u, v) on the quantization table QT. Linear quantization is processing which does a division and rounds off the division result for an integer.

[0051] The Huffman coding section 130 creates the compression image data ZZ (drawing 6 (e)) by carrying out Huffman coding of this DCT multiplier QF (u, v). In addition, about the approach of Huffman coding, it mentions later further. The compression image data ZZ contains the 1st data showing the base quantity child-ized table BQT, and the 2nd data showing the quantization level multiplier QCx and a transform coefficient QF (u, v) so that it may mention later.

[0052] If the compression image data ZZ is given to image data decompression equipment 200, the Huffman decryption section 210 will decrypt the compression image data ZZ, and it will ask for the DCT multiplier QF (u, v) (drawing 6 (f)). Since Huffman coding is reversible coding, this DCT multiplier QF (u, v) is the same as the DCT multiplier QF (u, v) (drawing 6 (b)) after the quantization called for by the quantization section 120 of image data compression equipment 100. In addition, the Huffman decryption section 210 also decrypts the base quantity child-ized table BQT (drawing 6 (c)) and the quantization level multiplier QCx which are contained in the compression image data ZZ other than the DCT multiplier QF (u, v), and is given to the reverse quantization table creation section 250.

[0053] The reverse quantization table creation section 250 creates the quantization table QT (drawing 6 (d)) by carrying out the multiplication of the base quantity child-ized table BQT and the quantization level multiplier QCx. The reverse quantization section 220 carries out the multiplication of this quantization table QT and the DCT multiplier QF (u, v), and asks for the decoded DCT multiplier FF (u, v) which is shown in drawing 6 (g).

[0054] The IDCT section 230 performs two-dimensional DCT inverse transformation shown in the following formula 3 to this DCT multiplier FF (u, v), and creates the restored image data ff (x y).

[Equation 3]

$$ff(x,y) = \frac{1}{4} \sum_{u=0}^{7} \sum_{v=0}^{7} C(u)C(v)\ FF(u,v)\ \cos\frac{\pi(2x+1)u}{16}\ \cos\frac{\pi(2y+1)v}{16}$$

$$C(u),\ C(v) = \frac{1}{\sqrt{2}} \quad (u,\ v = 0\ \text{の時})$$

$$= 1 \quad (u,\ v \neq 0\ \text{の時})$$

[0055] B. Adjustment of the quantization table QT by the quantization level multiplier QCx : since it is created by carrying out the multiplication of the base quantity child-ized table BQT and the quantization level multiplier QCx according to said formula 2, the quantization table QT can enlarge each quantization level in the quantization table QT, if the value of the quantization level multiplier QCx is enlarged. In case the value of the quantization level multiplier QCx compresses image data in image data compression equipment 100, an operator chooses it from two or more values (0-15) defined beforehand.

[0056] Drawing 7 is the explanatory view showing compression/expanding actuation at the time of specifying the quantization level multiplier QCx as 4. The quantization table creation section 140 and the reverse quantization table creation section 250 create the quantization table QT shown in drawing 7 (d) according to the above-mentioned formula 2. However, in this example, the maximum of quantization level is restricted to 15 and all the values of the quantization level from which the result of multiplication becomes 15 or more are compulsorily set as 15.
[0057] If linear quantization of the DCT multiplier F (u, v) of drawing 7 (a) is carried out using the quantization table QT shown in drawing 7 (d), as shown in drawing 7 (b), DC component will be 1 and the DCT multiplier QF (u, v) all whose AC components are 0 will be obtained. Thus, if the value of the quantization level multiplier QCx is enlarged, since the number of 0 in the quantized DCT multiplier QF (u, v) will increase, a data compression rate can be raised. However, since the decoded DCT multiplier FF (u, v) which is shown in drawing 7 (g) shows the DCT multiplier F (u, v) and a value which becomes and is different of the origin shown in drawing 7 (a), it is larger than the case (drawing 6) where the quantization level multiplier QCx is equal to 1. [of degradation of image quality]
[0058] By the way, since DC component of a DCT multiplier shows the average of the image data within the pixel block PB, its effect to image quality is quite large. Therefore, it is desirable to keep the quantization level for DC components the same as the value in the base quantity child-ized table BQT irrespective of the value of the quantization level multiplier QCx. Drawing 8 is the explanatory view showing the processing in such a case, and the quantization level QT (0 0) for DC components is kept compulsory at 1. In the case of QT(0 0) =1, since DC component of the decoded DCT multiplier FF (u, v) which is shown in drawing 8 (g) is maintained at the same value as DC component of the original DCT multiplier F (u, v) shown in drawing 8 (a), degradation of image quality can be suppressed comparatively small with compressibility comparable as the case of drawing 7 . In addition, it is not necessary to necessarily set quantization level QT (0 0) for DC components to 1, and it may set up other any value.
[0059] It is also possible to choose 0 as a quantization level multiplier QCx. As shown at drawing 9 in the case of QCx=0, all the quantization level in the quantization table QT is set as 1. Since the quantized DCT multiplier QF (u, v) is the same as the original DCT multiplier F (u, v), although compressibility is small, compression/expanding can be performed by high definition.
[0060] If the above is summarized, the quantization table creation section 140 and the reverse quantization table creation section 250 have the following descriptions.
(1) Create the quantization table QT by carrying out the multiplication of the base quantity child-ized table BQT and the quantization level multiplier QCx according to a formula 2.
(2) The result of multiplication sets up equally to maximum the thing more than the maximum (= 15) of quantization level (drawing 6 - drawing 8).
(3) Keep the quantization level QT (0 0) for DC components the same as that of the value in the base quantity child-ized table BQT irrespective of the value of the quantization level multiplier QCx (drawing 8).
(4) When the quantization level multiplier QCx is 0, set all quantization level as 1 (drawing 9).
[0061] The above-mentioned operation which asks for the quantization table QT is performed by the software program in image data compression equipment 100, and it is carried out by the reverse quantization table creation section 250 which consisted of hardware of dedication in image data decompression equipment 200. About the concrete circuitry of the reverse quantization table creation section 250, it mentions later further.
[0062] In addition, in case the quantization level multiplier QCx compresses image data with image data compression equipment 100, it can specify a value which uses a keyboard 103 and a mouse 104 and is different for every pixel block PB.
[0063] C. Huffman coding and the configuration of compressed data; the Huffman coding section 130 (drawing 1) of image data compression equipment 100 consists of the DC multiplier coding section and the AC multiplier coding section. Drawing 10 (A) is the block diagram showing the function of DC multiplier coding section. the block delay section 131 and an adder 132 are shown in drawing 10 (B) --

as -- DC multiplier DCi of each pixel block PB DC multiplier DCi-1 of the pixel block PB before one difference -- **DC is computed.
[0064] the category-ized table showing the categorizing processing section 133 in drawing 11 -- following -- the difference of DC multiplier -- it asks for Category SSSS and the discernment data ID corresponding to **DC. Category SSSS -- the difference of DC multiplier -- it is the number which shows the range of **DC. two or more difference as which the discernment data ID are specified by Category SSSS -- it is data in which it is shown from the smaller one in **DC the value of what position it is.
[0065] Category SSSS is changed into the Huffman-coding word HFDC for DC multipliers in the 1 more-dimensional Huffman coding section 134 (drawing 10). Drawing 12 is the explanatory view showing an example of the Huffman-coding table HTDC used by the 1-dimensional Huffman coding section 134. In this example, the subject-copy image data f (x y) shall be expressed by the YUV signal (a luminance signal Y and two color-difference signals U and V). The Huffman-coding table for DC multipliers of U signal / V signal common use only contains the symbolic language of the category SSSS of 0-9. On the other hand, the Huffman-coding table for DC multipliers for Y signals contains the symbolic language of the category SSSS of 15-31 other than the symbolic language of the category SSSS of 0-9. the null which mentions the Huffman-coding word of SSSS=15 later -- it is shown that it is run data. null -- run data are data in which it is shown that the pixel block PB of a uniform color continues. Moreover, the Huffman-coding word of SSSS=16-31 is a sign which shows the value of the quantization level multiplier QCx. For example, the Huffman-coding word "111110000" over SSSS=16 shows QCx=0, and the Huffman-coding word "111111111" over SSSS=31 shows QCx=15. In addition, meaning decode is possible for the Huffman-coding word of drawing 12 about all of category SSSS=1-9, and 15-31, and instant decode is possible for it.
[0066] Drawing 13 is the block diagram showing the function of AC multiplier coding section in the Huffman coding section 130. List direct [of the array F of AC multiplier (u, v) (except for u=v=0)] is first carried out to one dimension by the zigzag scan section 135. Drawing 14 is the explanatory view showing the usual route of a zigzag scan.
[0067] The value of AC multiplier by which list direct [of the judgment section 136] was carried out to one dimension judges whether it is 0. If the value of AC multiplier is 0, the run length counter 137 will change AC multiplier of continuous 0 into the zero run length NNNN. If AC multiplier is not 0, the value of the AC multiplier will be changed into Category SSSS and the discernment data ID by the categorizing section 138. Under the present circumstances, the category-ized table shown in drawing 11 is referred to.
[0068] The zero run length NNNN and Category SSSS are changed into the Huffman-coding word HFAC for AC multipliers in the two-dimensional Huffman coding section 139. Drawing 15 is the explanatory view showing the two-dimensional Huffman-coding table HTAC for AC multipliers. Moreover, drawing 16 shows an example of the Huffman-coding word of the parts (topmost part of two lines in drawing 15) of NNNN=0 and NNNN=1 in the Huffman-coding table HTAC. In addition, the Huffman-coding word "11111" of NNNN/SSSS=0/0 shows termination of the code data to one pixel block.
[0069] Drawing 17 is the explanatory view showing an example of Huffman coding. Drawing 17 (B) shows coding of DC multiplier. When the value of DC multiplier in the pixel block before one is assumed to be 0, it is **DC=F(0 0) =12. According to the category-ized table of drawing 11 , the category SSSS of **DC=12 is 4 and the discernment data ID are "1100." Moreover, according to the Huffman-coding table for DC multipliers of drawing 12 , the Huffman-coding word HFDC of category SSSS=4 is "011." In addition, the Huffman-coding table for Y signals is used here. Huffman coding (HF+ID) to DC multiplier is set to "0111100" as shown in drawing 17 (B).
[0070] Drawing 17 (C) shows coding of AC multiplier. First, AC multiplier is put in order by the array of a single dimension with a zigzag scan. This array is changed into the category SSSS of the value which are not the zero run length NNNN and zero (refer to drawing 11). The combination of the zero run length NNNN and Category SSSS is changed into the Huffman-coding word HFAC by the

Huffman-coding table for AC multipliers shown in drawing 15 and drawing 16 , and it is combined with the discernment data ID of AC multiplier which is not zero, and as shown in drawing 17 (C), Huffman coding (HFAC+ID) is created.
[0071] Drawing 18 is the explanatory view showing the configuration of compressed data. The whole compressed data consists of a header unit, the compressed data section, and the dummy section, as shown in drawing 18 (A). The header unit has 1 byte of four data DFH, DFL, DLH, and DLL, respectively. The first two data DFH and DFL show the class of data contained in the compressed data section. There is a class of the data of the base quantity child-ized table BQT, full color natural picture compression data, run length picture compression data, etc. of the data of the compressed data section. Data (DLH+DLL) of 16 bits of posterior parts of a header show the data length of the sum total of the compressed data section and the dummy section. Since the compressed data section is variable-length data containing Huffman coding, the data length of the sum total with the dummy section is adjusted so that it may become the die length of the integral multiple of WORD (= 2 bytes).
[0072] Drawing 18 (B) shows the configuration of the compressed data showing the base quantity child-ized table BQT. This one-set compressed data contains the data showing the base quantity child-ized table BQT for Y signals, and the data showing the base quantity child-ized table BQT of U signal / V signal common use. In addition, it is not necessary to carry out Huffman coding of the data showing the base quantity child-ized table BQT.
[0073] Drawing 18 (C) shows the configuration of the compressed data of a full color natural image. the code data (symbolic language of category SSSS=16-31 in drawing 12) which expresses the quantization level multiplier QCx to the compressed data section, the block data which is code data of each pixel block, and the null which shows two or more pixel blocks of a uniform color -- run data are included.
[0074] As shown in drawing 18 (D), the block data of one unit consists of 4 sets of data for Y signals, 1 set of U signal data, and 1 set of data for V signals. Drawing 19 is the explanatory view showing the relation of a block of each signal of YUV. As shown in drawing 19 (A), one screen in this example has the magnitude of the 256 pixel x240 scanning line. About a Y signal, DCT conversion is performed for every 8x8-pixel pixel block, without culling out. On the other hand, about U signal and V signal, as shown in drawing 19 (B), it is thinned out and (subsampling) made one half in a longitudinal direction and a lengthwise direction, and DCT conversion is performed to the 8x8-pixel block after thinning out. Therefore, as shown in drawing 19 (C), the field of four pixel blocks Y1-Y4 of a Y signal is equivalent to the field of one pixel block of U signal and V signal. In addition, it is because it is comparatively insensible to change (change of U signal and V signal) of a color to operate U signal and V signal on a curtailed schedule, without operating a Y signal on a curtailed schedule although human being's eyes are comparatively sensitive to change (change of a Y signal) of brightness. Compressibility can be raised by thinning out only U signal and V signal, without degrading image quality too much. In addition, the block data of one unit shown in drawing 18 (D) arranges in order the Huffman-coding data of each field shown in drawing 19 (C).
[0075] The code data to one pixel block in block data consists of one Huffman-coding data of DC multiplier, and two or more Huffman-coding data of AC multiplier, as shown in drawing 18 (F). The Huffman-coding data of DC multiplier consist of a Huffman-coding word HFDC of Category SSSS, and discernment data ID, as mentioned above (drawing 18 (G)). Moreover, the Huffman-coding data of AC multiplier consist of the Huffman-coding words HFAC and the discernment data ID to combination with Category SSSS with the zero run length NNNN (drawing 18 (H)).
[0076] The code data of the quantization level multiplier QCx is inserted just before the block data of the pixel block which wants to change the head of the compressed data section, and the value of the quantization level multiplier QCx. To two or more pixel blocks before the 2nd quantization level multiplier QCx is inserted, the top quantization level multiplier QCx is used in common. Moreover, to two or more blocks before the 3rd quantization level multiplier QCx (not shown) is inserted, the 2nd quantization level multiplier QCx is used in common.
[0077] In addition, when the symbolic language of the quantization level multiplier QCx is not contained at the head of the compressed data section, it is considered that it is QCx=1. Therefore, also

when the quantization level multiplier QCx is not inserted in the head of the compressed data section but the quantization level multiplier QCx is inserted only once on the way, it is equivalent to two quantization level multipliers QCx being specified.
[0078] Since Huffman coding showing the quantization level multiplier QCx is inserted between block data, it can apply this new quantization level multiplier QCx easily to the next block data at the time of the new quantization level multiplier QCx being decrypted. Moreover, since the code data of the quantization level multiplier QCx is expressed with the Huffman-coding word for DC multipliers as shown in drawing 12 , even if this is inserted between block data, it is possible to judge immediately whether this code data is code data of DC multiplier for block Y1 or it is the code data of the quantization level multiplier QCx.
[0079] the null contained in the compressed data section -- run data are shown in drawing 18 (E) -- as -- null -- it consists of discernment data ID with the symbolic language for DC multipliers "NRL" which shows that it is run data, and the block count.
[0080] drawing 20 -- null -- it is the explanatory view showing the image expressed by run data. The background BG of the subject-copy image of drawing 20 (A) is applied in the uniform color. The part of the ellipse of drawing 20 (A) is assumed to be what 18 pixel blocks which have the image data value (f (x y) = 12) with all the same pixels as shown in drawing 20 (B) are following. the null to which drawing 20 (C) expresses these pixel blocks -- run data are shown. this null -- run data -- the 1st null for a 16-pixel block -- the run data NRD1 and the 2nd null for a 2-pixel block -- the run data NRD2 are included.

[0081] each -- null -- the head of the run data NRD1 and NRD2 -- null -- it has the symbolic language for DC multipliers "NRL" (symbolic language of category SSSS=15 of drawing 12 "1111011") which shows that it is run data. decrypting the symbolic language for DC multipliers in a head, since Huffman coding of DC multiplier is arranged at the head of the usual block data as shown in drawing 18 (F) -- null -- run data, block data, and the code data of the quantization level multiplier QCx -- a meaning -- and it is discriminable in an instant.
[0082] The block count is expressed with the Huffman-coding word for AC multipliers as shown in drawing 20 (C). drawing 21 -- the inside of the Huffman-coding table for AC multipliers (drawing 15) -- null -- it is drawing showing the part used for run data. null -- when used for run data, if the zero run length NNNN is equal to ([block count]-1), he will be set up. Moreover, the Huffman-coding word of category SSSS=1 is used noting that the value of AC multiplier is 1. the 1st null shown in drawing 20 (C) -- the data (NNNN/SSSS=15/1) of the block count in the run data NRD1 show that 16 pixel blocks of a uniform color are continuing. moreover, the 2nd null -- the data (NNNN/SSSS=1/1) of the block count in the run data NRD2 show that two pixel blocks of a uniform color are continuing.
[0083] each -- null -- the discernment data ID are added to the back end of the run data NRD1 and NRD2. It is fixed to ID=1 in this example.
[0084] null -- run data can express that two or more pixel blocks which continued with about 20-bit data are uniform colors in this way for the usual block data's, expressing the one-set block (the Y signal shown in drawing 19 -- a 4-pixel block, U signal, and V signal -- an every 1pixelblock -- it contains) of a uniform color on the other hand -- about 300- about 400 bits is required. And also when it is shown that a two or more sets pixel block is a uniform color, it is [about 300 - 400 bits of abbreviation] required about each set. therefore, null -- if run data are used, it is possible to reduce considerably the amount of data of the compressed data showing the pixel block of a majority of continuous uniform colors.
[0085] in addition, null -- the value of the luminance signal Y of a pixel block of a uniform color and color-difference signals U and V expressed by run data is not included in compressed data, but is specified in the software program which describes video game. He specifies the brightness and color tone of these blocks using a keyboard 103 or a mouse 104 while he specifies the range of the field (drawing 20 (A) the background BG) of a pixel block of a uniform color with a mouse 104, in case an operator creates the software program for video game. When carrying out like this and a specific event occurs while having performed the game, for example using video game equipment 20 (drawing 3), the special visual effectiveness of changing the color of Background BG in time can be produced. in

addition, null -- about the concrete circuitry which decrypts run data, it mentions later further.

[0086] D. The detail configuration of the reverse quantization table creation section : drawing 22 is the block diagram showing the internal configuration of the reverse quantization table creation section 250 shown in drawing 1 . The reverse quantization table creation section 250 is equipped with the multiplication unit 254 which carries out the multiplication of the address-generation circuit 252 which generates the address of RAM251 and RAM251 which memorizes the base quantity child-ized table BQT, the latch circuit 253 holding the quantization level multiplier QCx, and the quantization level multiplier QCx and the base quantity child-ized table BQT, and generates the quantization table QT. The quantization table QT which was caused multiplication unit 254 and created is supplied to the reverse quantization section 220.

[0087] First, if the compression image data ZZ contained by CD-ROM is given to the Huffman decryption section 210, the code data of the base quantity child-ized table BQT will be decrypted first, and will be supplied to RAM251. This base quantity child-ized table BQT is memorized by RAM251 according to the light address given from the address-generation circuit 252. The base quantity child-ized table BQT memorized by RAM251 is used to all pixel blocks.

[0088] The address-generation circuit 252 generates the lead address synchronizing with the DCT multiplier data QF (u, v) outputted from the Huffman decryption section 210, and the base quantity child-ized table BQT is read from RAM251 according to this lead address. On the other hand, the quantization level multiplier QCx decrypted in the Huffman decryption section 210 is latched by the latch circuit 253, and it is saved at a latch circuit 253 until the following quantization level multiplier QCx is given. Therefore, the same quantization level multiplier QCx is used in common to two or more pixel blocks until the quantization level multiplier QCx is newly supplied.

[0089] Drawing 23 is the block diagram showing the internal configuration of the latch circuit 253 contained in the reverse quantization table creation section 250 (drawing 22), and the multiplication unit 254. The latch circuit 253 consists of two latches 402,404. The multiplication unit 254 has the synchronous-clock creation circuit 412, AND circuit 414, U signal start detector 416, V signal start detector 418, NAND circuit 420, the selector 422, the multiplier 424, the clipping circuit 426, and the zero value correction circuit 428.

[0090] Drawing 24 is a timing chart which shows actuation of the circuit shown in drawing 23 . If the quantization level multiplier QCx is decrypted in the Huffman decryption section 210 (drawing 1), the data of the quantization level multiplier QCx will be given to a latch circuit 253 with an enable signal QEN (drawing 24 (a), (b)). The 1st latch 402 latches the quantization level multiplier QCx by the rising edge of an enable signal QEN, and supplies an output Q1 to the 2nd latch 404 (drawing 24 (c)).

[0091] As shown in drawing 24 (d), after the base quantity child-ized table BQT for Y signals is read 4 times, the base quantity child-ized table BQT of U signal / V signal common use is read twice from RAM251 (drawing 22).

[0092] Synchronizing with the base quantity child-ized table BQT read from RAM251, it is set to L level in the period of a Y signal, and block recognition signal UV/Y used as H level is given to the synchronous-clock creation circuit 412 (drawing 23) from the address-generation circuit 252 in the period of U signal and V signal (drawing 24 (e)). Moreover, an enable signal EN is also given to the synchronous-clock creation circuit 412 in this case. The synchronous-clock creation circuit 412 reverses block recognition signal UV/Y, generates a synchronizing clock signal SCK (drawing 24 (f)), and supplies this to the 2nd latch's 404 clock input terminal. The 2nd latch 404 latches the 1st latch's 402 output Q1 by the rising edge of this synchronizing clock signal SCK, and supplies that output Q2 (drawing 24 (g)) to the data input terminal of a selector 422. In addition, the fixed value "1" is given to other data input terminals of a selector 422.

[0093] U signal start detector 416 generates U start signal USTRT (drawing 24 (h)) which shows the start time of day of the base quantity child-ized table BQT for U signals based on the block recognition signals UV/Y and the 10MHz basic clock signal CLK. This U start signal USTRT is a signal set to L level from the rising edge of block recognition signal UV/Y only for 100 nanoseconds.

[0094] Six blocks Y1-Y4, and the block change signal SWTCH (drawing 24 (i)) and the block

recognition signals UV/Y with which level changes by turns in each period of U and V are given to AND circuit 414. V signal start detector 418 generates V start signal VSTRT (drawing 24 (j)) which shows the start time of day of the base quantity child-ized table BQT for V signals based on the output of AND circuit 414, and the 10MHz basic clock signal CLK. Block recognition signal UV/Y of this V start signal VSTRT is the signal set to L level from the rising edge of the block change signal SWTCH only for 100 nanoseconds in the period of H level.

[0095] Drawing 25 is the block diagram showing the internal configuration of U signal start detector 416 and V signal start detector 418. These circuits 416,418 are constituted from a D flip-flop and a NAND circuit by both. The block recognition signals UV/Y are supplied to D input terminal of D flip-flop 432 of U signal start detector 416, and the 10MHz basic clock signal CLK is inputted into the clock input terminal. Block recognition signal UV/Y and the reversal output of D flip-flop 432 are given to the input terminal of NAND circuit 434. In addition, block recognition signal UV/Y synchronizes with the basic clock signal CLK.

[0096] Since the block recognition signals UV/Y is [the reversal output of D flip-flop 432] H level between L level, the output USTRT of NAND circuit 434 is maintained at H level (refer to drawing 24 (h)). If the output (U start signal USTRT) of NAND circuit 434 is set to L level and D flip-flop 432 latches an input with the edge of the basic clock signal CLK after 100 nanoseconds immediately after block recognition signal UV/Y changes from L level to H level, the output USTRT of NAND circuit 434 will return to H level again.

[0097] Actuation of V signal start detector 418 is the same as actuation of U signal start detector 416. However, since the AND of block recognition signal UV/Y and the block change signal SWTCH is given to D input terminal of D flip-flop 436, in the period of H level, V start signal VSTRT is set to L level from the rising edge of the block change signal SWTCH by block recognition signal UV/Y only for 100 nanoseconds.

[0098] U start signal USTRT and V start signal VSTRT are inputted into NAND circuit 420 (drawing 23), and the output (selection signal SEL) is supplied to the selection input terminal of a selector 422. A selection signal SEL (drawing 24 (k)) is set to H level only for 100 nanoseconds at the beginning of the period the start of the period for U signals, and for V signals. A selector 422 outputs the output Q2 given from the latch circuit 253 as it is, when a selection signal SEL is L level, and on the other hand, when a selection signal SEL is H level, it outputs a fixed value "1." The multiplication of the output Q3 of a selector 422 is carried out to the base quantity child-ized table BQT by the multiplier 424.

[0099] As shown in drawing 24 (l), the output Q3 of a selector 422 is surely set to "1" irrespective of the value of the quantization level multiplier QCx at the beginning of the period the start of the period for U signals, and for V signals. The period for 100 nanoseconds which the period the object for U signals and for V signals begins is a period for computing the quantization level for DC multipliers. Therefore, if the circuit of drawing 23 is used, it can avoid performing substantially the multiplication of the quantization level for DC multipliers used for U signal and V signal, and the specified quantization level multiplier QCx. If it puts in another way, the circuit shown in drawing 23 will be a circuit which realizes the operation shown in drawing 8 (c) and (d).

[0100] As shown in drawing 23 , the output of a multiplier 424 is corrected by a clipping circuit 426 and the zero value correction circuit 428, and serves as the final quantization table QT. Drawing 26 is the block diagram showing the internal configuration of these two circuits 426,428.

[0101] The clipping circuit 426 consists of 4 input OR circuit 450 and eight 2 input OR circuits 452. These circuits are circuits in the case of expressing quantization level by 9 bits (the most significant bit being a sign bit). D9-D12 are inputted into 4 input OR circuit 450 4 bits of high orders except a sign bit D13 among the 14-bit data outputted from the multiplier 424 (drawing 23). The output of 4 input OR circuit 450 is given to one input terminal of eight 2 input OR circuits 452, and D1-D8 are given to the input terminal of another side 8 bits of low order of the output of a multiplier 424. When at least one value of D9-D12 is "1" 4 bits of high orders, all of the output of eight 2 input OR circuits 452 are set to "1." Therefore, the output of a clipping circuit 426 is set to the case of 255 or more for the output of a multiplier 424 by 255 with a decimal number.

[0102] In the zero value correction circuit 428, the output of seven 2 input OR circuits 452 seven bits D2 in a clipping circuit 426 - for D8 is outputted as it is. Moreover, the output and sign bit D13 of these seven 2 input OR circuits 452 are given to eight inverters 460, respectively. The output of eight inverters 460 is given to 8 input AND circuit 462, and the output of this AND circuit 462 is supplied to 2 input OR circuit 464. The output of 2 input OR circuit 452 for least significant bit D1 is given to this 2 input OR circuit 464. Consequently, when [of the output of a multiplier 424] all of 13 bits of values of D1-D13 are "0", as for the zero value correction circuit 428, the value of 8 bits of others [value / of the least significant bit] outputs the quantization level QT of "0" by "1." If it puts in another way, the zero value correction circuit 420 will have realized the operation shown in drawing 9 (c) and (d).
[0103] E. null -- decryption [of run data]: -- drawing 27 is the block diagram showing the internal configuration of the Huffman decryption section 210 (drawing 1) in image data decompression equipment 200. The Huffman decryption section 210 is equipped with the decryption section 470 which carries out the Huffman decryption of the compression image data ZZ, the control section 472, the selector 474, and DC multiplier register 476.
[0104] the class of compressed data with which the decryption section 470 was given -- the base quantity child-ized table BQT, the quantization level multiplier QCx, block data, and null -- it judges any of run data they are, and the condition signal SS which shows the class of compressed data is supplied to a control section 472. A control section 472 supplies control signals CTL1, CTL2, and CTL3 to the decryption section 470, a selector 474, and MPU40 (drawing 3) of video game equipment according to this condition signal SS, respectively. The base quantity child-ized table BQT and the quantization level multiplier QCx which were decrypted are supplied to the reverse quantization table creation section 250 from the decryption section 470. The DCT multiplier QF (u, v) which quantized after decode is supplied to a selector 474 from the decryption section 470.
[0105] The DC multiplier QF (0 0) registered into the zero data and DC multiplier register 476 other than the DCT multiplier QF (u, v) given from the decryption section 470 is given to the data input terminal of a selector 474. The value of the DC multiplier QF (0 0) of a pixel block of the uniform color described in the software program of a game is written in DC multiplier register 476 by MPU40 of video game equipment. In addition, the value from which the DC multiplier QF (0 0) differs to a YUV signal, respectively is registered.
[0106] two null shown in drawing 20 (C) here -- the case where the run data NRD1 and NRD2 are decrypted is considered. the 1st null -- if the data NRL of the head of the run data NRD1 are detected by the decryption section 470 -- null -- the condition signal SS which tells that it is run data is outputted to a control section 472 from the decryption section 470. A control section 472 is controlled to output control signals CTL1 and CTL2 to the decryption section 470 and MPU40 immediately according to the condition signal SS, respectively, and to stop decryption actuation. Moreover, a control section 472 supplies a control signal CTL3 to a selector 474, and makes the DC multiplier QF (0 0) registered into DC multiplier register 476 choose as a DC multiplier of the first block. As shown in drawing 20 (B), when the value of the subject-copy image data f (x y) is 12, QF(0 0) =12 are registered into DC multiplier register 476. A control section 472 controls a selector 474 as an AC multiplier of 63 pieces further to choose zero data altogether. Drawing 28 shows the DCT multiplier QF (u, v) created in this way.
[0107] the 1st null -- since the run data NRD1 show that 16 blocks of a uniform color are continuing, the DCT multiplier QF (u, v) shown in drawing 28 is created about each of 16 pixel blocks. the 2nd null -- the DCT multiplier QF (u, v) shown in drawing 28 is similarly created [each / of two blocks] about the run data NRD2.
[0108] null -- after processing of run data is completed, a control section 472 outputs control signals CTL1 and CTL2 to the decryption section 470 and MPU40, and it controls to resume decryption actuation. null -- the value of the luminance signal Y of a pixel block and color-difference signals U and V as which it is specified that it is a uniform color can be easily changed with run data by changing the value of DC multiplier written in DC multiplier register 476 from MPU40. if it puts in another way -- null -- if run data are used, the color of the image field of a uniform color can be changed into a desired

color according to data other than compression image data. In this example, the value of the luminance signal Y of a block of a uniform color and color-difference signals U and V is specified in the software program which describes video game.
[0109] Drawing 29 is the block diagram showing other configurations of the Huffman decryption section. In this Huffman decryption section 210a, the DCT multiplier QF (u, v) outputted from the decryption section 470 bypasses a selector 474, and is directly given to the reverse quantization section 220. A selector 474 chooses one side of the DC multiplier QF (0 0) given from DC multiplier register 476, and zero data, bypasses the reverse quantization section 220, and supplies it to the IDCT section 230 directly. The control section 478 is outputting the 4th control signal CTL4 other than the three same control signals CTL1-CTL3 as drawing 27 to the IDCT section 230.
[0110] A control section 478 outputs control signals CTRL1, CTL2, and CTL4 to the decryption section 470, MPU40, and the IDCT section 230 according to the condition signal SS which shows the class of compressed data, respectively. Decode of the block data usual in the decryption section 470 supplies the decrypted DCT multiplier QF (u, v) to the reverse quantization section 220.
[0111] the 1st null shown in drawing 20 (C) -- if the data NRL of the head of the run data NDR 1 are detected by the decryption section 470 -- null -- the condition signal SS which tells that it is run data is outputted to a control section 478 from the decryption section 470. A control section 478 is controlled to output control signals CTL1 and CTL2 to the decryption section 470 and MPU40 immediately according to the condition signal SS, respectively, and to stop decryption actuation. Moreover, a control section 478 switches the level of the control signal CTL3 given to a selector 474, and makes the DC multiplier QF (0 0) registered into DC multiplier register 476 choose. A control section 478 controls a selector 474 as an AC multiplier of 63 pieces further to choose zero data altogether. A control section 478 outputs a control signal CTL4 to coincidence to the IDCT section 230, and controls it to choose and carry out inverse transformation of the output of a selector 474.
[0112] null -- after processing of run data is completed, control signals CTL1 and CTL2 are outputted to the decryption section 470 and MPU40 from a control section 478, and it controls to resume decode actuation.
[0113] thus -- the circuit shown in drawing 29 -- null -- in the case of processing of run data, since the DCT multiplier QF (u, v) outputted from a selector 474 bypasses the reverse quantization section 220 and is directly supplied to the IDCT section 230, there is an advantage that the operation error by reverse quantization does not arise. For example, since the operation error by quantization is pressed down by min when the video encoder unit 50 (drawing 3) performs chroma-key processing which detects the part of a specific color and is made into a transparent plane color, it is possible to make the pixel block of a desired color into a transparent plane color certainly.
[0114] the above-mentioned example -- setting -- null -- although it enabled it to set only DC multiplier as arbitration with run data, it is also possible to enable it to set up a desired value to the predetermined part (for example, QF (1 0) and QF (0 1)) of AC multiplier. in this case, null -- run data express the number of a series of pixel blocks which has the same image pattern.
[0115] F. modification: -- the range which this invention is not restricted to the above-mentioned example, and does not deviate from that summary in addition -- setting -- various voice -- it is possible to set like and to carry out, for example, the following deformation is also possible.
[0116] (1) Although two-dimensional DCT conversion was taken up as orthogonal transformation in the above-mentioned example, to this invention, the orthogonal transformation (for example, K-L conversion and a Hadamard transform) of arbitration is available. Moreover, as entropy code modulation, coding (for example, algebraic-sign-izing and MEL coding) of arbitration other than Huffman coding can be used.
[0117] (2) You may realize by hardware and image data compression equipment 100 may realize image data decompression equipment 200 by software. Drawing 30 is a flow chart which shows the procedure of the processing which elongates the compressed data shown in drawing 18 with software. At step S1, the contents of compressed data are judged from the value of a header unit. When compressed data expresses the base quantity child-ized table BQT, in step S2, the base quantity child-ized table BQT is

memorized in memory, and it returns to step S1.
[0118] When compressed data expresses the image, the class of initial data of each data unit contained in compressed data circles in step S3 is judged. the code data of the quantization level multiplier QCx indicated to be a data unit to drawing 18 (C) here, block data, and null -- each of run data is meant. the Huffman-coding word which expresses the quantization level multiplier QCx as initial data of a data unit as shown in drawing 18 (C), (D), (E), and (F), the Huffman-coding word of DC multiplier **DC of block data, and null -- there are three kinds of the Huffman-coding words NRL showing a run.
[0119] When initial data are the Huffman-coding words of the quantization level multiplier QCx, in step S4, the quantization table QT is created by multiplying by this quantization level multiplier QCx and the base quantity child-ized table BQT. In addition, when the value of that the description mentioned above on the occasion of this multiplication, i.e., (1) multiplication result, sets the quantization level more than maximum as maximum, not quantizing (2) DC multiplier, and (3) quantization level multiplier QCx is 0, setting-as 1-all quantization level ** is realized. If the quantization table QT is created in step S4, it will return to step S3.
[0120] When it is judged that initial data are the Huffman-coding words of DC multiplier **DC in step S3, the data for a 1-pixel block are decrypted in step S5, and the DCT multiplier QF (u, v) is obtained. Reverse quantization is performed at step S6, and two-dimensional DCT inverse transformation is performed at step S7. If processing of steps S5-S7 is repeated about all pixel blocks included in one-set block data (drawing 18 (D)), it will return from step S8 to step S3.
[0121] step S3 -- setting -- initial data -- null -- when it is judged that it is the Huffman-coding word NRL which shows that it is run data, while DC component of a 1-pixel block is set as the value specified beforehand in step S9, all of 63 AC components are set as 0. At step S10, two-dimensional DCT inverse transformation is performed to the DCT multiplier created in this way. null -- only the block count specified by run data will return from step S11 to step S3, if step S9 and processing of S10 are repeated. In this way, image data ff (x y) is restored by covering all the compressed data sections and performing processing of steps S3-S11.
[0122] (3) Although the above-mentioned example showed the example which applied this invention to video game equipment, this invention can be applied to all kinds of image processing system.
[0123] (4) Although the quantization level multiplier QCx and each quantization level in the quantization table QT were made into the integer in the above-mentioned example, a number including a decimal is sufficient as these.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram showing the function of the compression equipment of image data, and expanding equipment which applied one example of this invention.
[Drawing 2] The block diagram showing the concrete configuration of image data compression equipment 100.
[Drawing 3] The block diagram showing the concrete configuration of image data decompression equipment 200.
[Drawing 4] The top view showing a subject-copy image.
[Drawing 5] The explanatory view showing the array of the DCT multiplier F (u, v).
[Drawing 6] The explanatory view showing basic actuation of compression/expanding.
[Drawing 7] The explanatory view showing compression/expanding actuation in case the quantization level multiplier QCx is 4.
[Drawing 8] The explanatory view showing the actuation when not changing DC component in quantization.
[Drawing 9] The explanatory view showing compression/expanding actuation in case the quantization level multiplier QCx is 0.
[Drawing 10] The block diagram showing the function of DC multiplier coding section.
[Drawing 11] Drawing showing the category-ized table in Huffman coding.
[Drawing 12] The explanatory view showing an example of the Huffman-coding table HTDC for DC multipliers.
[Drawing 13] The block diagram showing the function of AC multiplier coding section.
[Drawing 14] The explanatory view showing the usual route of a zigzag scan of AC multiplier.
[Drawing 15] The explanatory view showing the two-dimensional Huffman-coding table for AC multipliers.
[Drawing 16] Drawing showing the contents of the Huffman-coding table.
[Drawing 17] The explanatory view showing an example of Huffman coding.
[Drawing 18] The explanatory view showing the configuration of compressed data.
[Drawing 19] The explanatory view showing the relation of a block of each signal of YUV.
[Drawing 20] null -- the explanatory view showing the image expressed by run data.
[Drawing 21] Drawing showing other parts of the Huffman-coding table for AC multipliers.
[Drawing 22] The block diagram showing the internal configuration of the reverse quantization table creation section 250.
[Drawing 23] The block diagram showing the internal configuration of a latch circuit 253 and the multiplication unit 254.
[Drawing 24] The timing chart which shows actuation of the circuit shown in drawing 23 .
[Drawing 25] The block diagram showing the internal configuration of U signal start detector 416 and V signal start detector 418.
[Drawing 26] The block diagram showing the internal configuration of a clipping circuit 426 and the

zero value correction circuit 428.
[Drawing 27] The block diagram showing the internal configuration of the Huffman decryption section 210.
[Drawing 28] null -- drawing showing the DCT multiplier which decrypted run data and was obtained.
[Drawing 29] The block diagram showing other configurations of the Huffman decryption section.
[Drawing 30] The flow chart which shows the procedure of the processing which decodes compressed data with software.
[Drawing 31] The block diagram showing conventional image data compression equipment and expanding equipment.
[Description of Notations]
20 -- Video game equipment
21 -- ROM
24 26 -- Gamepad
28 -- Color television
30 -- Video signal cable
32 -- CD-ROM drive
34 -- Loudspeaker
36 -- SCSI bus
38 -- Loudspeaker
40 -- MPU
40a -- Operation part
40b -- Controller
41 -- Main memory
42 -- ROM
43 -- M-BUS
45 -- Picture signal control unit
45 a--MPUI/F
45 b--SCSI controller
45 c--AFFIN converter
45d -- Graphic controller
45e -- Sound controller
49 -- VDP unit
50 -- Video encoder unit
50a -- Look-up table
50b -- Priority setting section
50c -- Mixer
50c -- Image merge section
50d -- Superimposition section
50 e--DAC
52 -- Voice output unit
The 52 a--ADPCM sections
55 -- RAM
59 -- RAM
60 -- NTSC converter
100 -- Image data compression equipment
101 -- CPU
102 -- Main memory
103 -- Keyboard
104 -- Mouse
105 -- Magnetic disk drive
106 -- Optical-magnetic disc equipment

110 -- The DCT section
120 -- Quantization section
130 -- Huffman coding section
131 -- Block delay section
132 -- Adder
133 -- Categorizing processing section
134--1-dimensional Huffman coding section
135 -- Zigzag scan section
136 -- Judgment section
137 -- Run length counter
138 -- Categorizing section
140 -- Quantization table creation section
150 -- Huffman-coding table memory
200 -- Image data decompression equipment
210 -- Huffman decryption section
220 -- Reverse quantization section
230 -- The IDCT section
240 -- Huffman-coding table memory
250 -- Reverse quantization table creation section
251 -- RAM
252 -- Address-generation circuit
253 -- Latch circuit
254 -- Multiplication unit
402,404 -- Latch
412 -- Synchronous-clock creation circuit
414 -- AND circuit
416 -- U signal start detector
418 -- V signal start detector
420 -- NAND circuit
422 -- Selector
424 -- Multiplier
426 -- Clipping circuit
428 -- Zero value correction circuit
432,436 -- D flip-flop
434,438 -- NAND circuit
450 -- 4 input OR circuit
452 -- 2 input OR circuit
460 -- Inverter
462 -- AND circuit
464 -- OR circuit
470 -- Decryption section
472 -- Control section
474 -- Selector
476 -- DC multiplier register
478 -- Control section
540 -- Image data compression equipment
542 -- Orthogonal transformation section
544 -- Quantization section
546 -- Entropy-code-modulation section
550 -- Image data decompression equipment
550 -- Expanding equipment

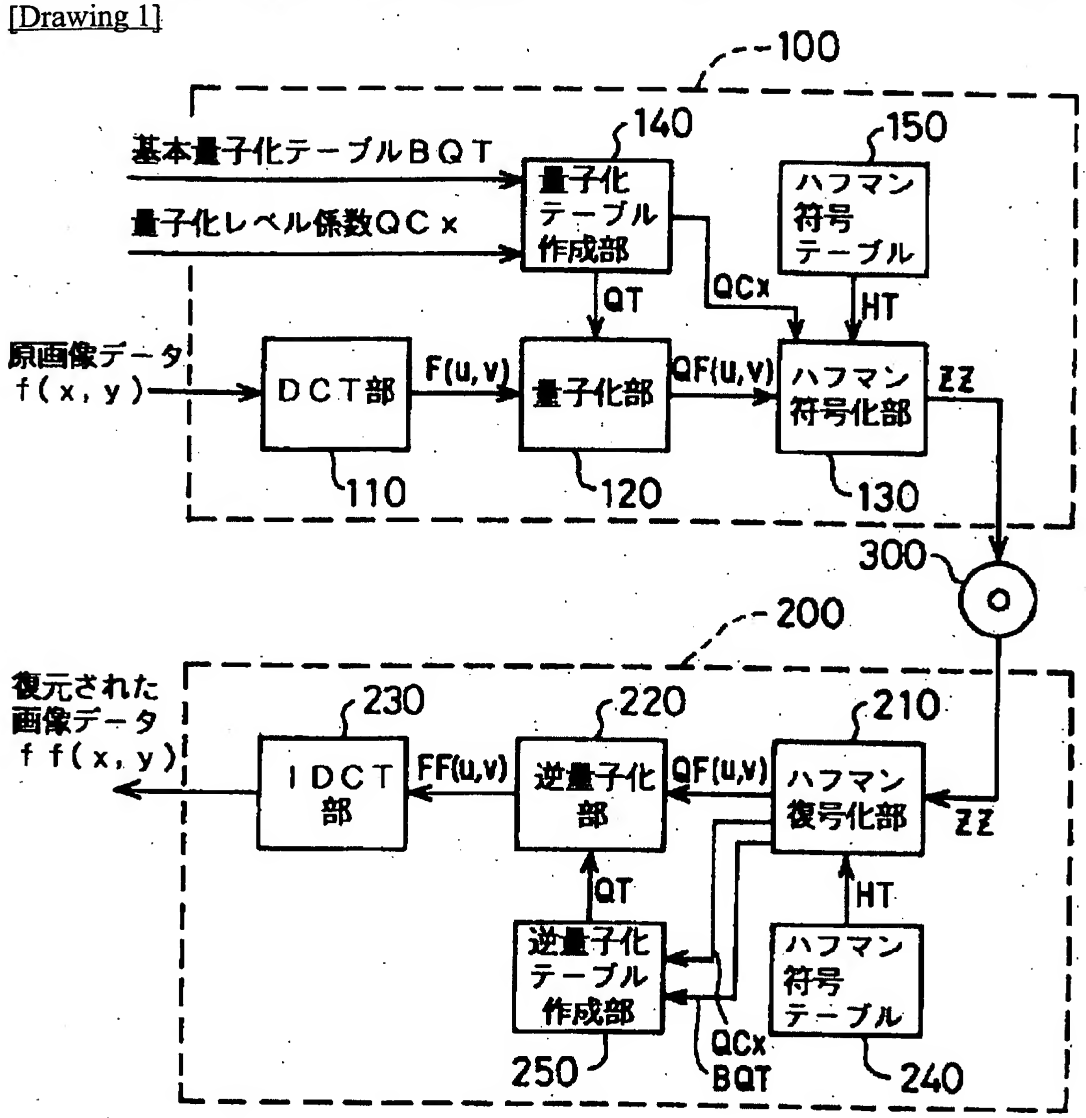
552 -- Reverse orthogonal transformation section
554 -- Reverse quantization section
556 -- Entropy decryption section
562 -- Quantization table
564 -- Sign table
BG -- Background
BQT -- Base quantity child-ized table
CLK -- Basic clock signal
D1-D13 -- Output of a multiplier 424
D13 -- Sign bit
EN -- Enable signal
f (x y) -- Subject-copy image data
Image data ff(ed) -- (x y) decoded
F (u, v) -- The original DCT multiplier
FF (u, v) -- Decoded DCT multiplier
The Huffman-coding word for HFAC--AC multipliers
The Huffman-coding word for HFDC--DC multipliers
The Huffman-coding table for HTAC--AC multipliers
The Huffman-coding table for HTDC--DC multipliers
HT -- Huffman-coding table
ID -- Discernment data
NNNN -- Zero run length
NRL-- null -- run data
PB -- Pixel block
PX -- Pixel
QCx -- Quantization level multiplier
QEN -- Enable signal
The DCT multiplier QF(ed) -- quantized
QT -- Quantization table
SCK -- Synchronizing clock signal
SEL -- Selection signal
SS -- Condition signal
SSSS -- Category
SWTCH -- Block change signal
U, V -- Color-difference signal
USTRT--U start signal
VSTRT--V start signal
Y -- Luminance signal
ZZ -- Compression image data

[Translation done.]

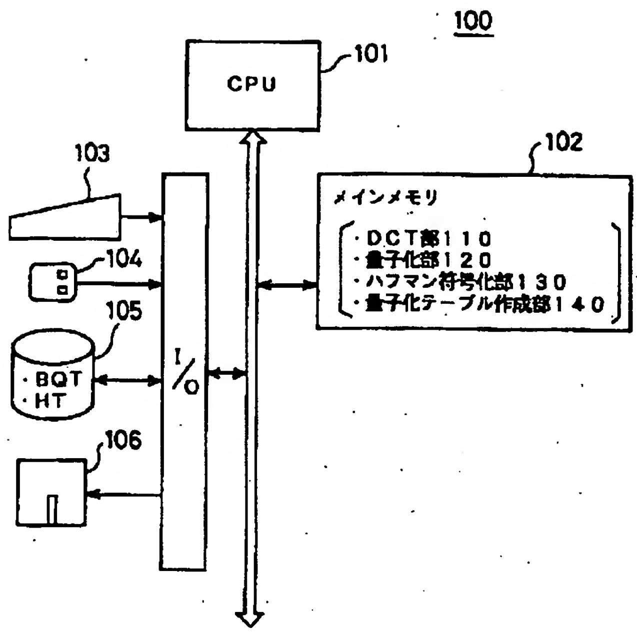
* NOTICES *

DRAWINGS

[Drawing 1]

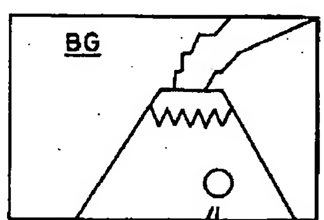


[Drawing 2]

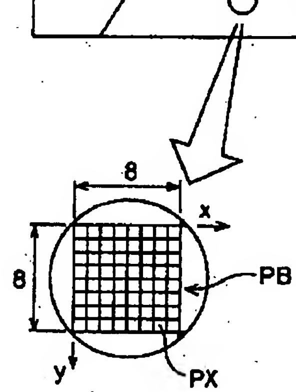


[Drawing 4]

(A)

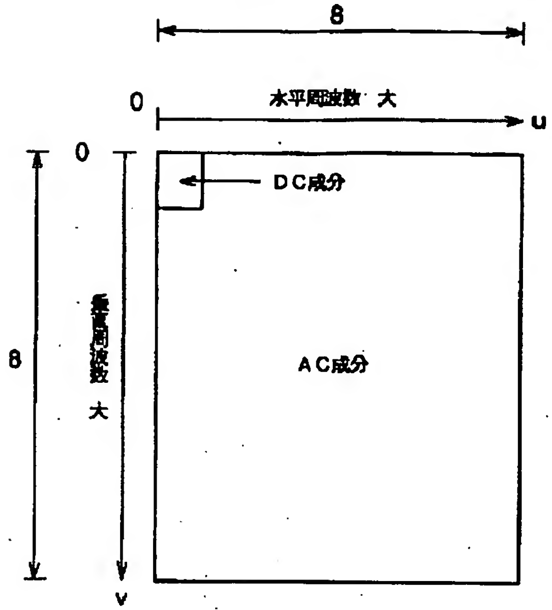


(B)



[Drawing 5]

変換係数F(u, v)の配列

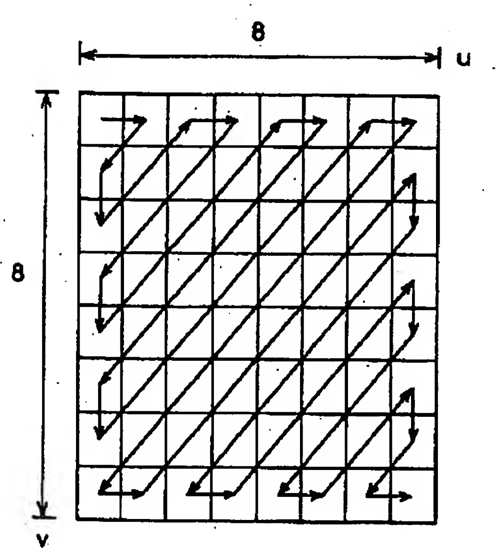


[Drawing 11]

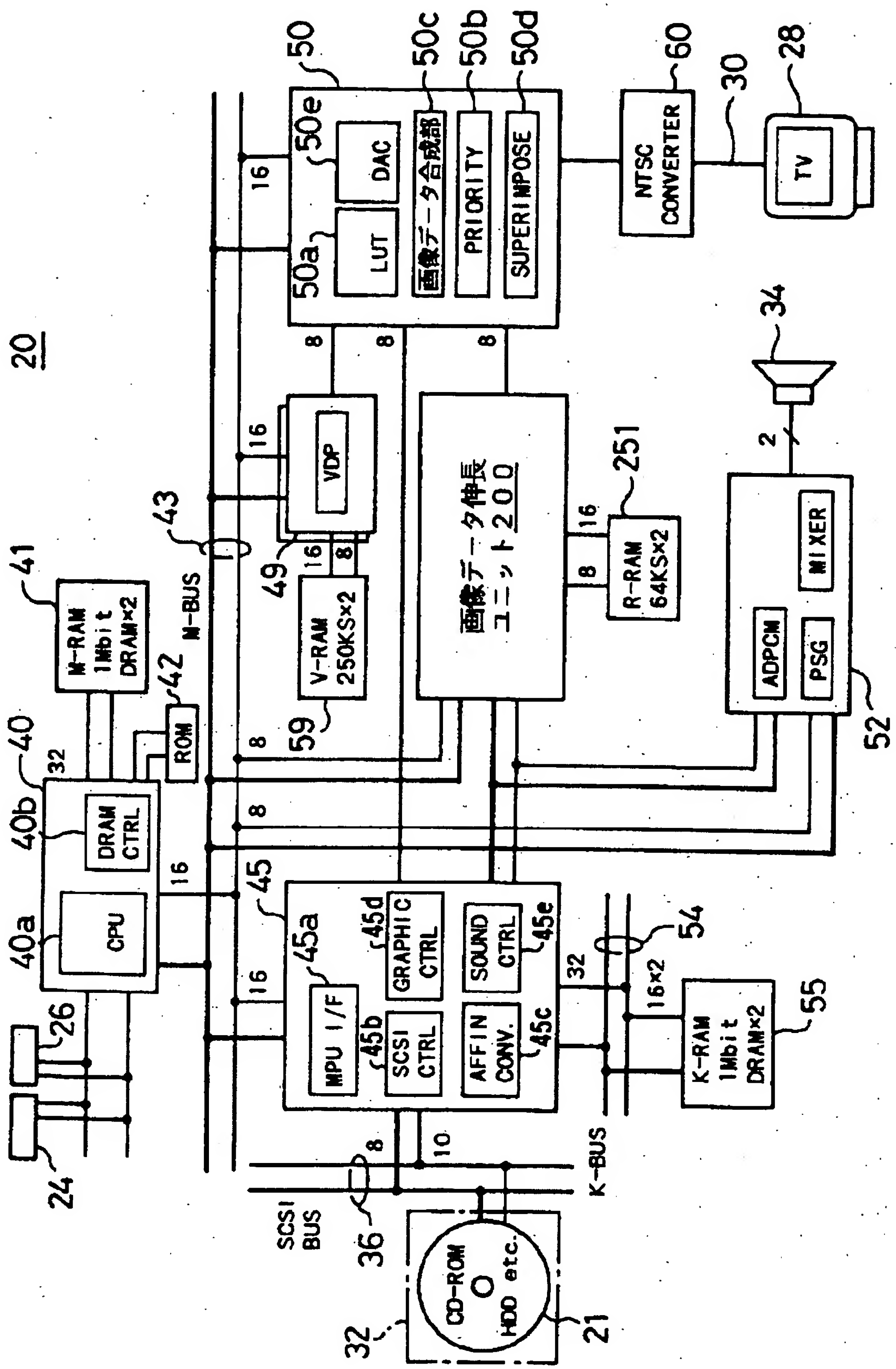
カテゴリ SSSS	ΔDC／AC 係数値	識別データ ビット数
0	0	0
1	-1, 1	1
2	-3..-2, 2..3	2
3	-7..-4, 4..7	3
4	-15..-8, 8..15	4
5	-31..-16, 16..31	5
6	-63..-32, 32..63	6
7	-127..-64, 64..127	7
8	-255..-128, 128..255	8
9	-511..-256, 256..511	9

[Drawing 14]

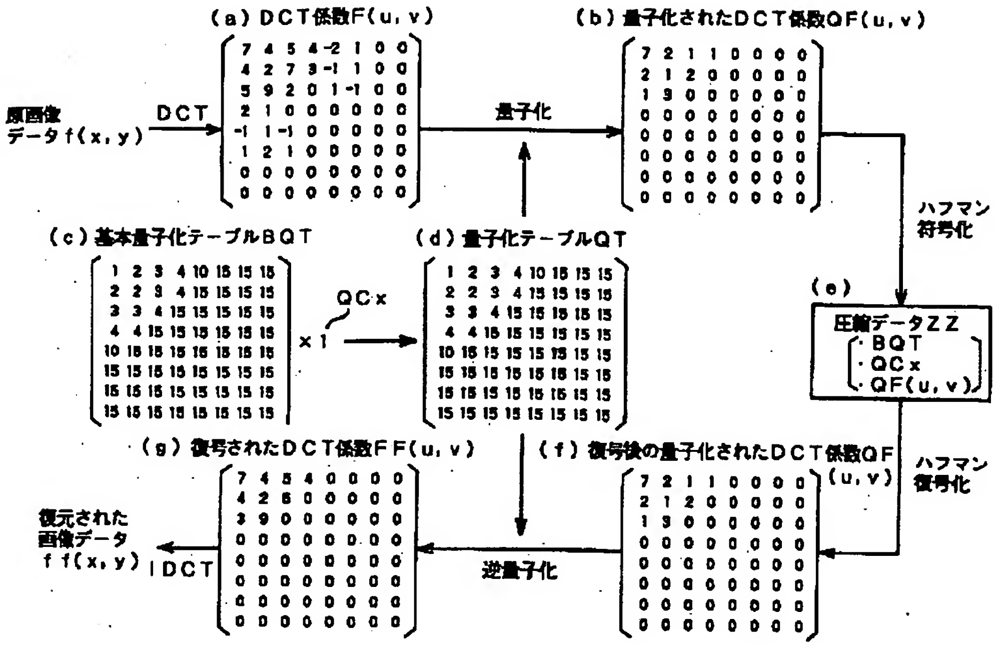
ジグザグスキャン



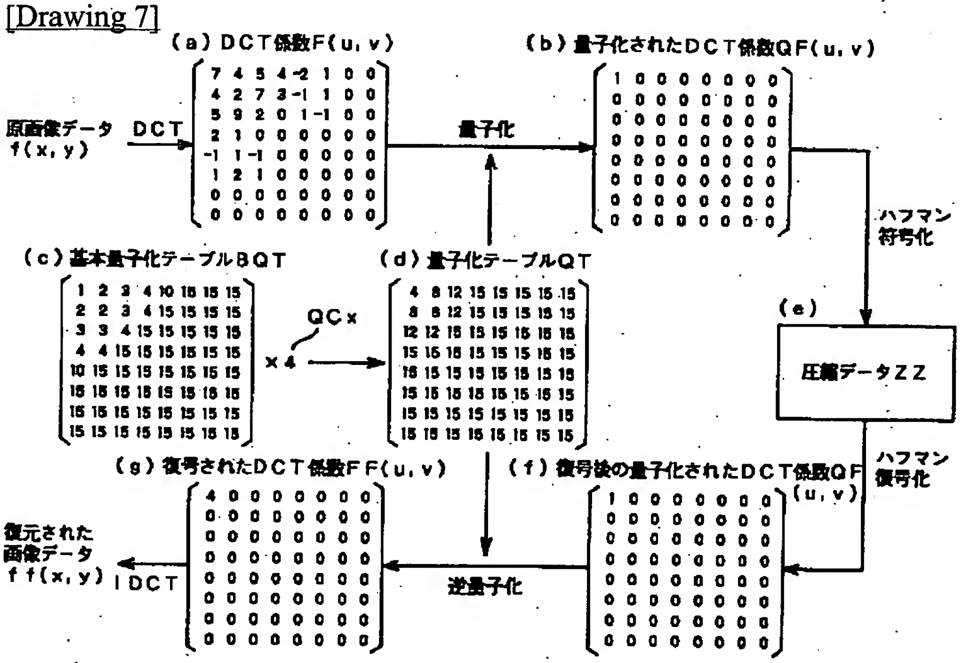
[Drawing 3]


20
M-RAM 1Mbit DRAM×2
ROM
CPU
DRAM CTRL
M-BUS
V-RAM 250KS×2
VDP
画像データ伸長ユニット200
R-RAM 64KS×2
LUT
DAC
画像データ合成部
PRIORITY
SUPERIMPOSE
NTSC CONVERTER
TV
ADPCM
PSG
MIXER
MPU I/F
SCSI CTRL
GRAPHIC CTRL
SOUND CTRL
AFFIN CONV.
K-RAM 1Mbit DRAM×2
K-BUS
SCSI BUS
CD-ROM
HDD etc.

[Drawing 6]



[Drawing 7]

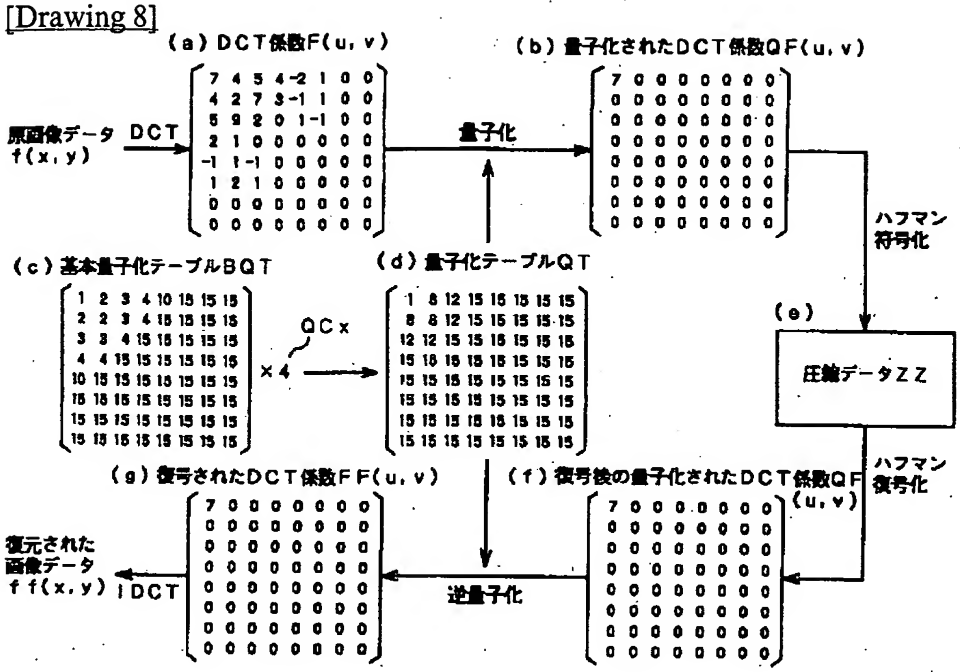


[Drawing 15]

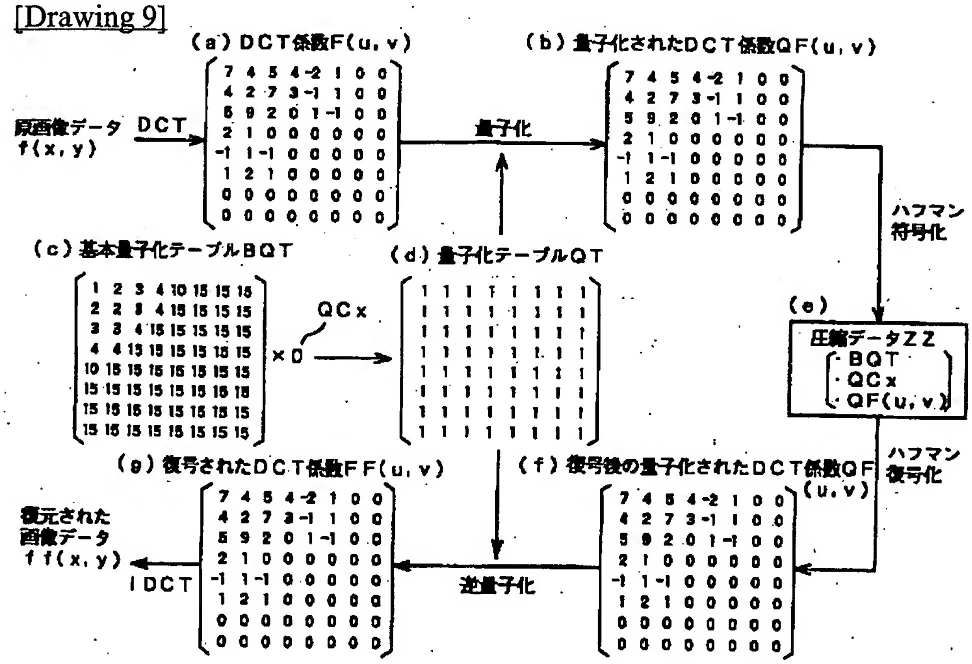
AC係数用ハフマン符号テーブル

		カテゴリSSSS	
		0	1 ---------- 9
ゼロラン長 NNNN	0	EOB	AC係数 ハフマン符号語 HFAC
	1	ZRL	
	2	—	
	15	—	

[Drawing 8]

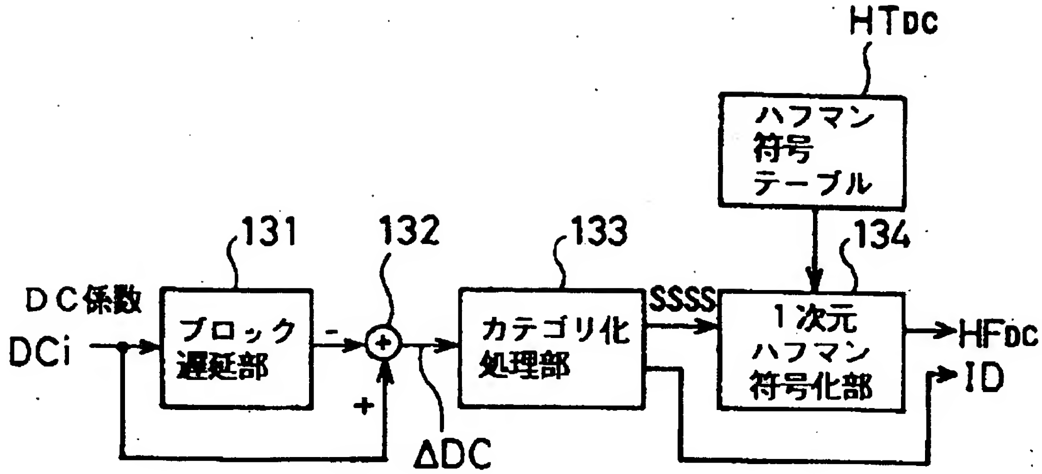


[Drawing 9]

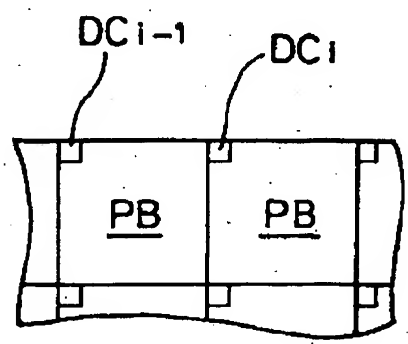


[Drawing 10]

(A)

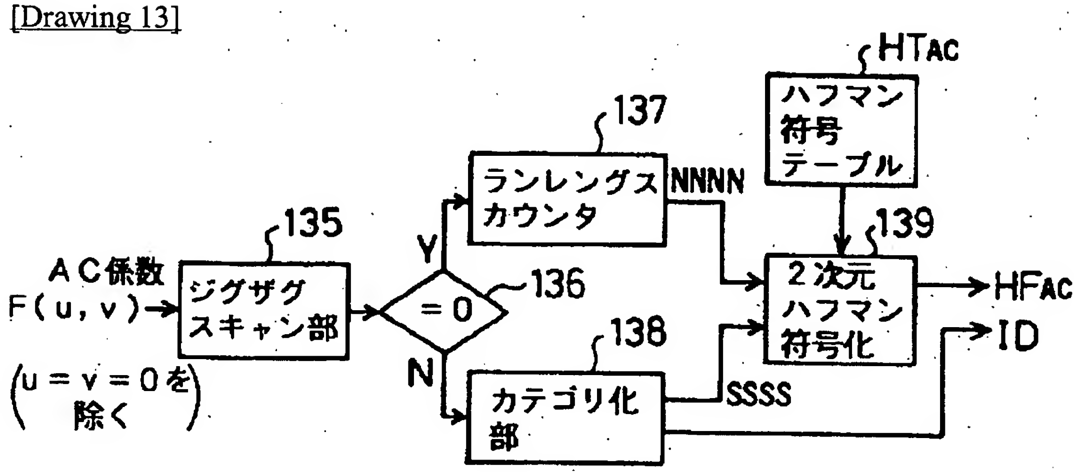


(B)



$\Delta DC = DC_i - DC_{i-1}$

[Drawing 13]



[Drawing 12]

カテゴリ SSSS	ΔDC 係数 ハフマン符号語 HF_{DC}	
	Y信号用	U信号、V信号用
0	000	00
1	1110	01
2	001	10
3	010	110
4	011	1110
5	100	11110
6	101	111110
7	110	1111110
8	111100	11111110
9	1111010	11111111
10		
11		
12		
13		
14		
15(NRL)	1111011	
16(QC0)	111110000	
17(QC1)	111110001	
18(QC2)	111110010	
19(QC3)	111110011	
20(QC4)	111110100	
21(QC5)	111110101	
22(QC6)	111110110	
23(QC7)	111110111	
24(QC8)	111111000	
25(QC9)	111111001	
26(QC10)	111111010	
27(QC11)	111111011	
28(QC12)	111111100	
29(QC13)	111111101	
30(QC14)	111111110	
31(QC15)	111111111	

[Drawing 16]

ゼロラン長 NNNN / カテゴリ SSSS	AC係数ハフマン符号語 HF_{AC}	
	Y信号用	U信号，V信号用
0/0 (EOB)	11111	11111
0/1	00	00
0/2	01	01
0/3	100	1010
0/4	1010	11000
0/5	11000	1110010
0/6	110110	111100010000
0/7	111011100	111100010001
0/8	111100010000	111100010010
0/9	11101111000	11101111000
1/0 (ZRL)	11110111111	11110111111
1/1	1011	100
1/2	11001	11001
1/3	1110100	1110011
1/4	111100010001	111100010011
1/5	111100010010	111100010100
1/6	111100010011	111100010101
1/7	111100010100	111100010110
1/8	111100010101	111100010111
1/9	11101111001	11101111001

[Drawing 17]

（A）DCT係数F(u, v)

DCi

12	0	4	0	0	0	1	0
-4	3	0	-2	0	0	0	0
0	5	3	0	1	0	0	0
-4	0	0	0	0	0	0	0
0	2	0	0	0	0	0	0
0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

（B）DC係数符号化（$DC_{i-1}=0$）

$\Delta DC=12 \rightarrow SSSS=4 \rightarrow HF_{DC}+ID=\underbrace{011}_{HF_{DC}}\underbrace{1100}_{ID}$

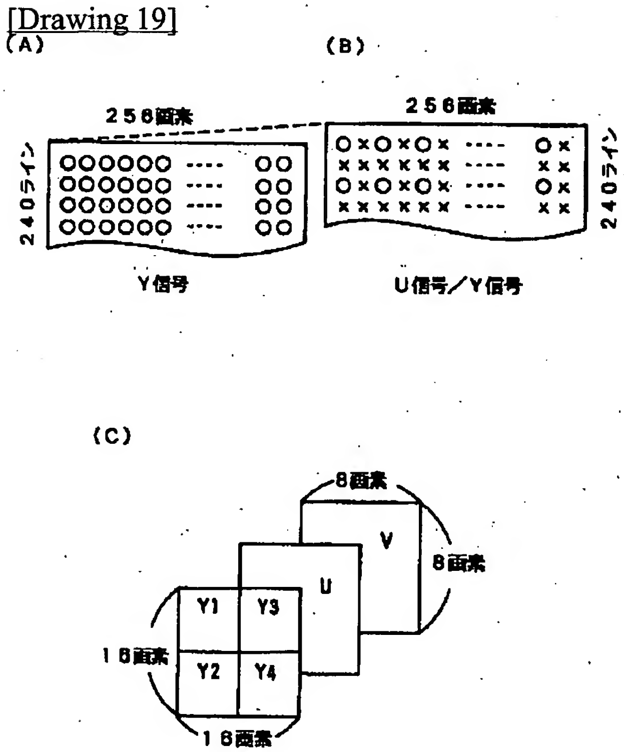
（C）AC係数符号化

・ジグザグスキャン ： $\underbrace{0, -4,}\ \underbrace{0, 3,}\ \underbrace{4,}\ \underbrace{0, 0, 5}$

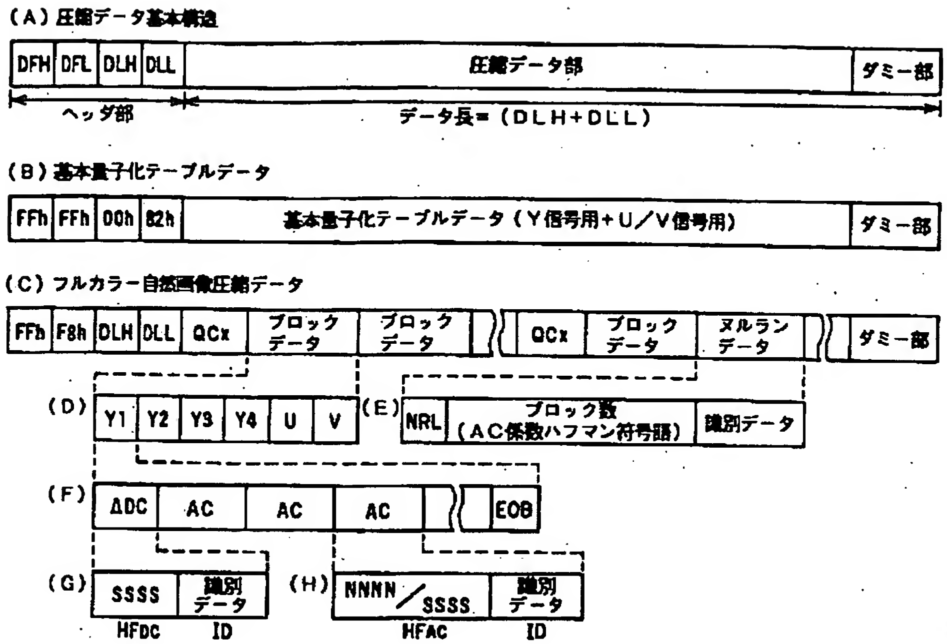
・NNNN／SSSS＝ 1／3　1／2　0／3　2／3

・ $HF_{AC}+ID = \underbrace{1110100011}\underbrace{1100111} = \underbrace{111010}_{HF_{AC}}\underbrace{0011}_{ID}\underbrace{11001}_{HF_{AC}}\underbrace{11}_{ID}$

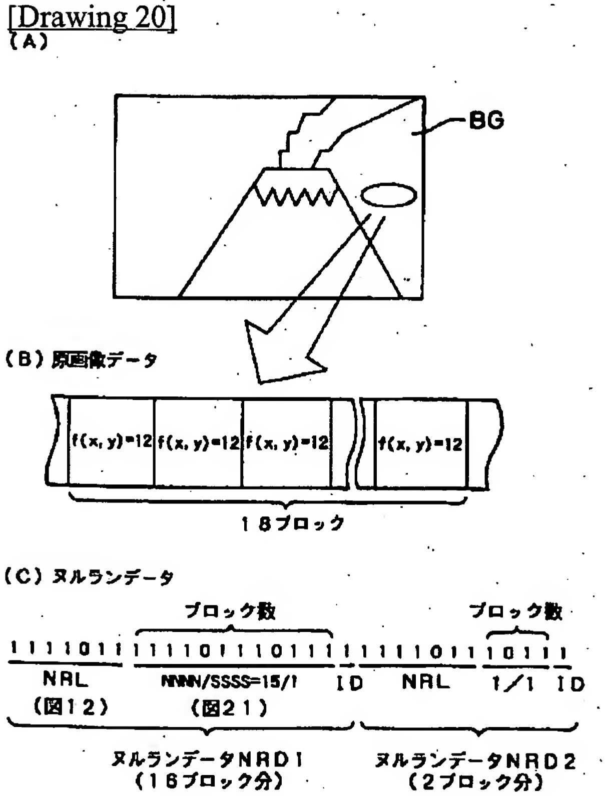
[Drawing 19]



[Drawing 18]



[Drawing 20]



[Drawing 21]

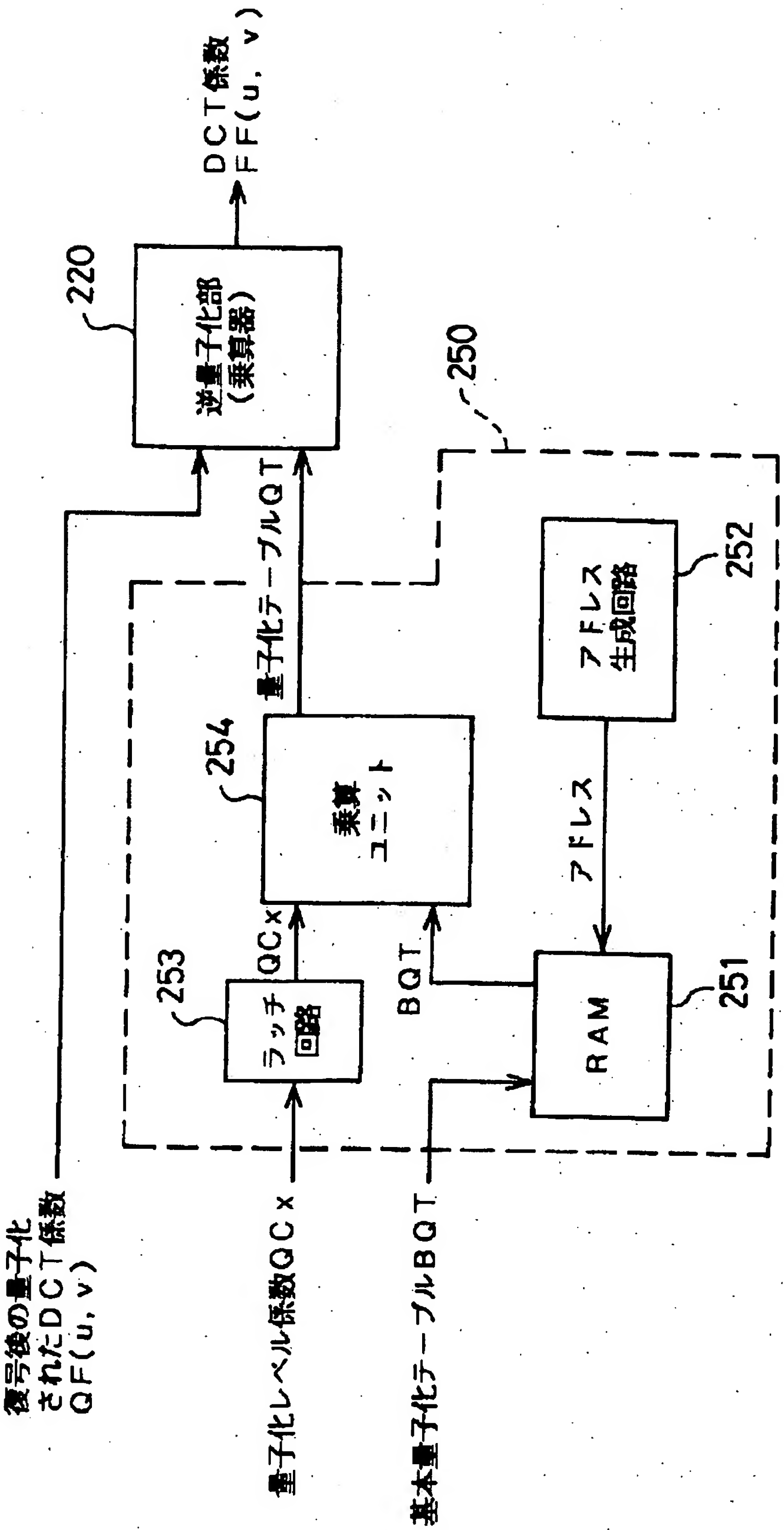
ゼロラン長 NNNN / カテゴリ SSSS	AC係数ハフマン符号語HFAC	
	Y信号用	U信号，V信号用
0/1	00	00
1/1	1011	100
2/1	11010	1011
3/1	110111	11010
4/1	111000	11011
5/1	111001	111000
6/1	1110110	1110101
7/1	111011101	1110110
8/1	111100111111	111011101
9/1	111101000111	111101000111
10/1	111101001111	111101001111
11/1	111101010111	111101010111
12/1	111101011111	111101011111
13/1	111101100111	111101100111
14/1	111101101111	111101101111
15/1	111101110111	111101110111

ヌルランデータに使用する場合：

NNNN＝［ブロック数］－１

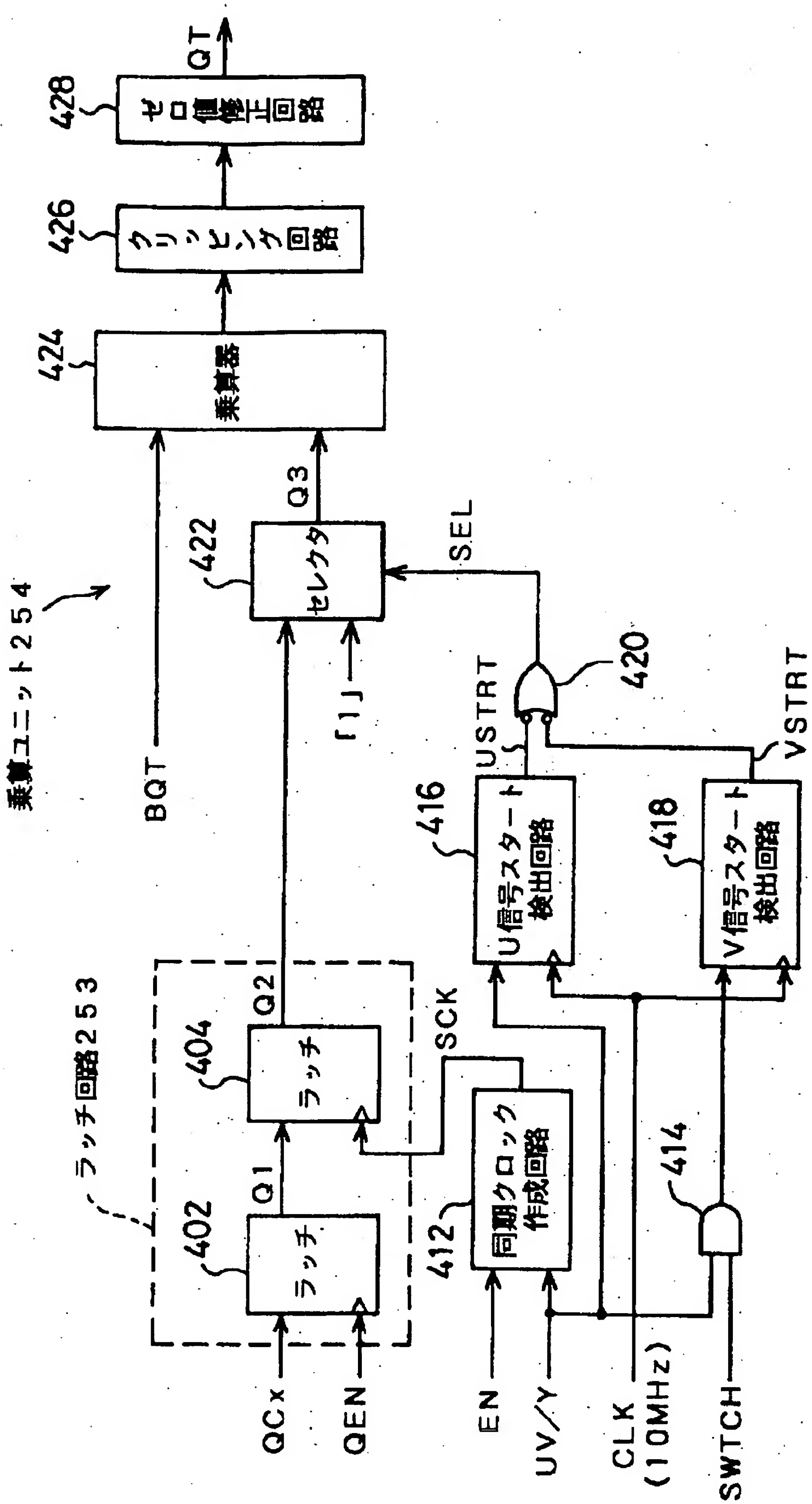
SSSS＝１

[Drawing 22]

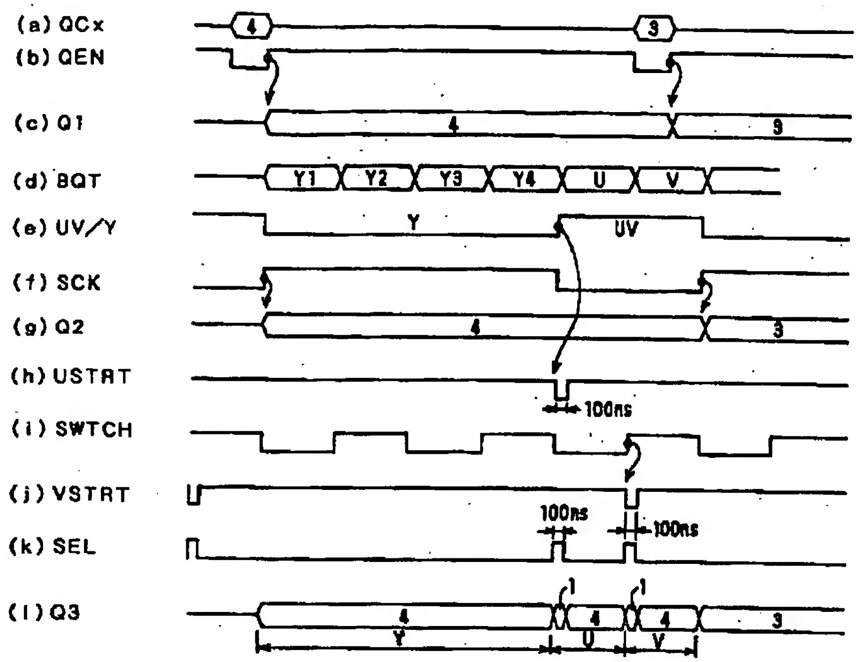


復号後の量子化されたDCT係数QF(u, v)
量子化レベル係数QCx
基本量子化テーブルBQT
250
253
ラッチ回路
QCx
BQT
254
乗算ユニット
RAM
251
アドレス
アドレス生成回路
252
量子化テーブルQT
220
逆量子化部（乗算器）
DCT係数FF(u, v)

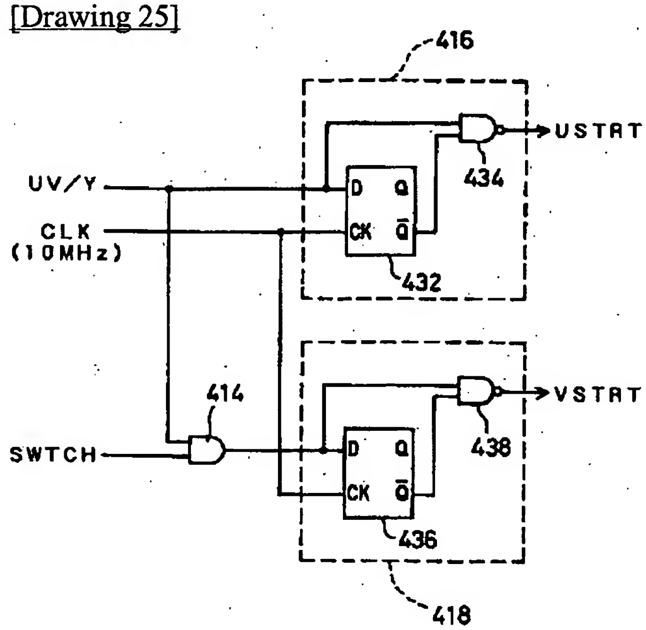
[Drawing 23]


乗算ユニット254
ラッチ回路253
402
ラッチ
404
ラッチ
Q1
Q2
QCx
QEN
SCK
412
同期クロック作成回路
EN
UV/Y
CLK
(10MHz)
SWTCH
414
416
U信号スタート検出回路
418
V信号スタート検出回路
USTRT
VSTRT
420
SEL
422
セレクタ
「1」
Q3
BQT
424
乗算器
426
クリッピング回路
428
ゼロ値修正回路
QT

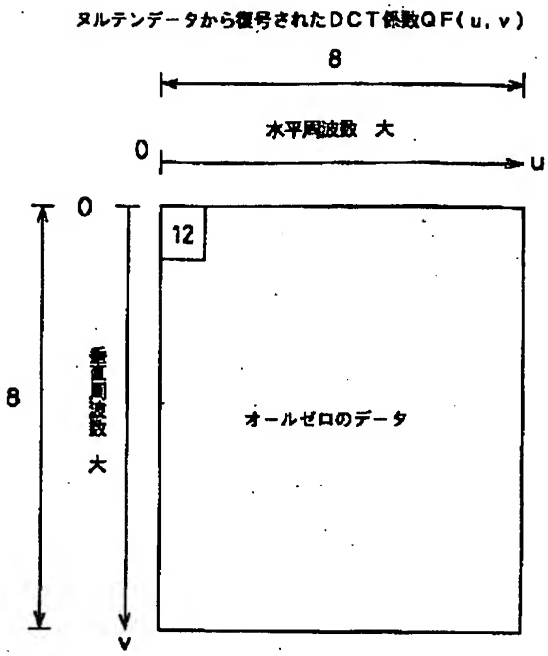
[Drawing 24]



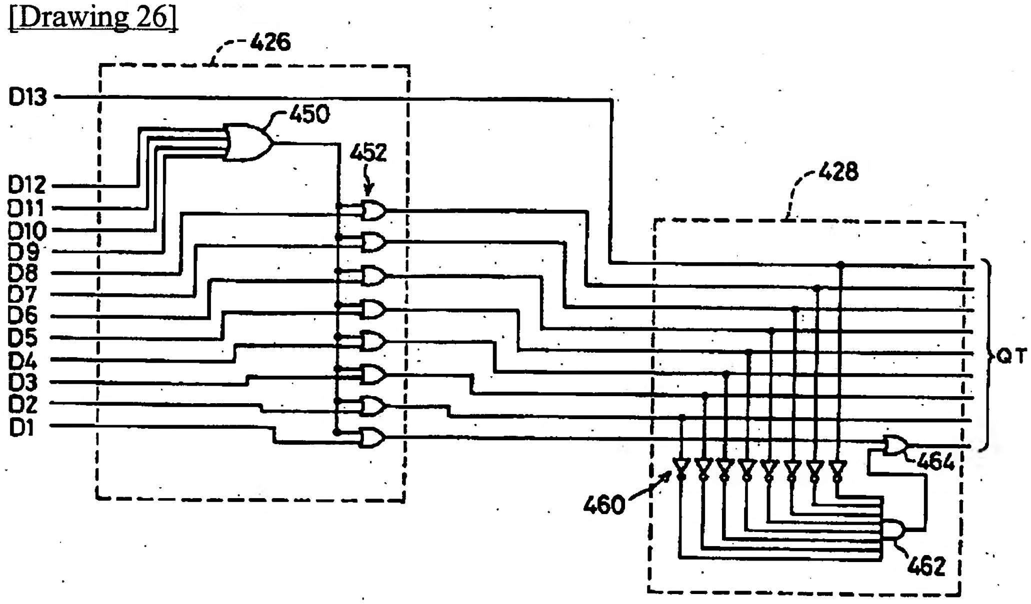
[Drawing 25]



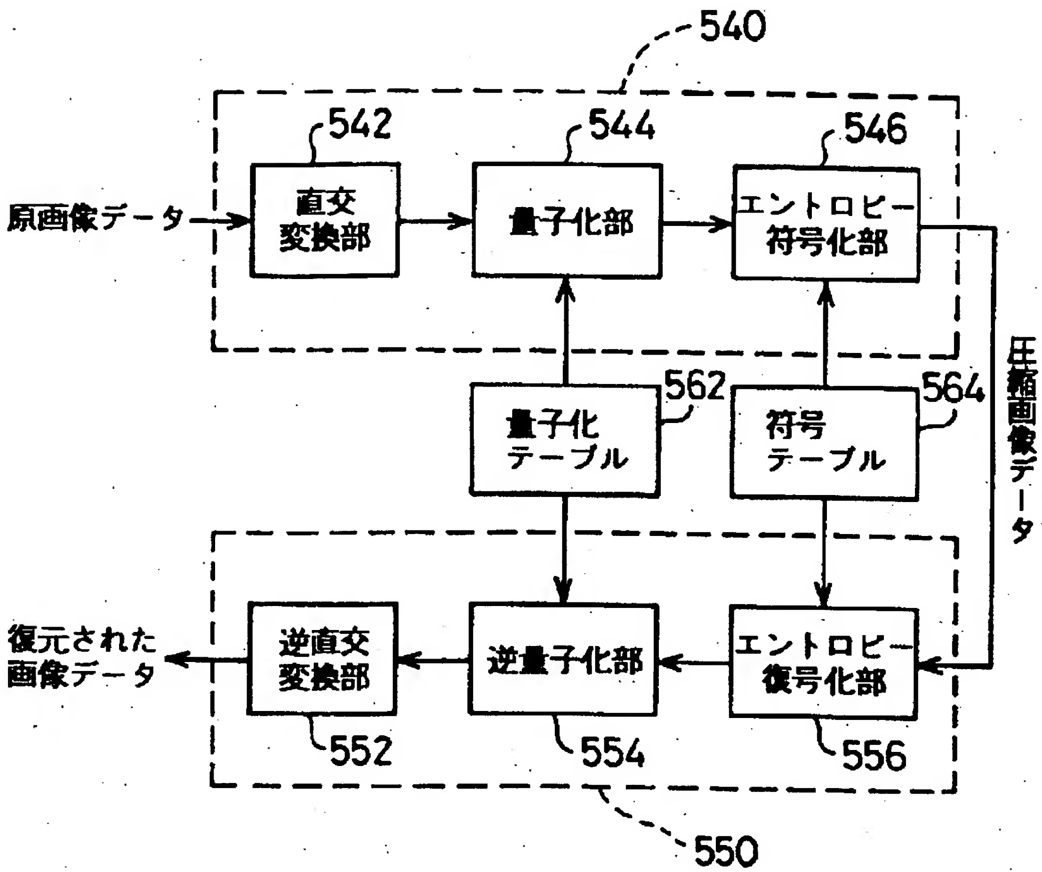
[Drawing 28]



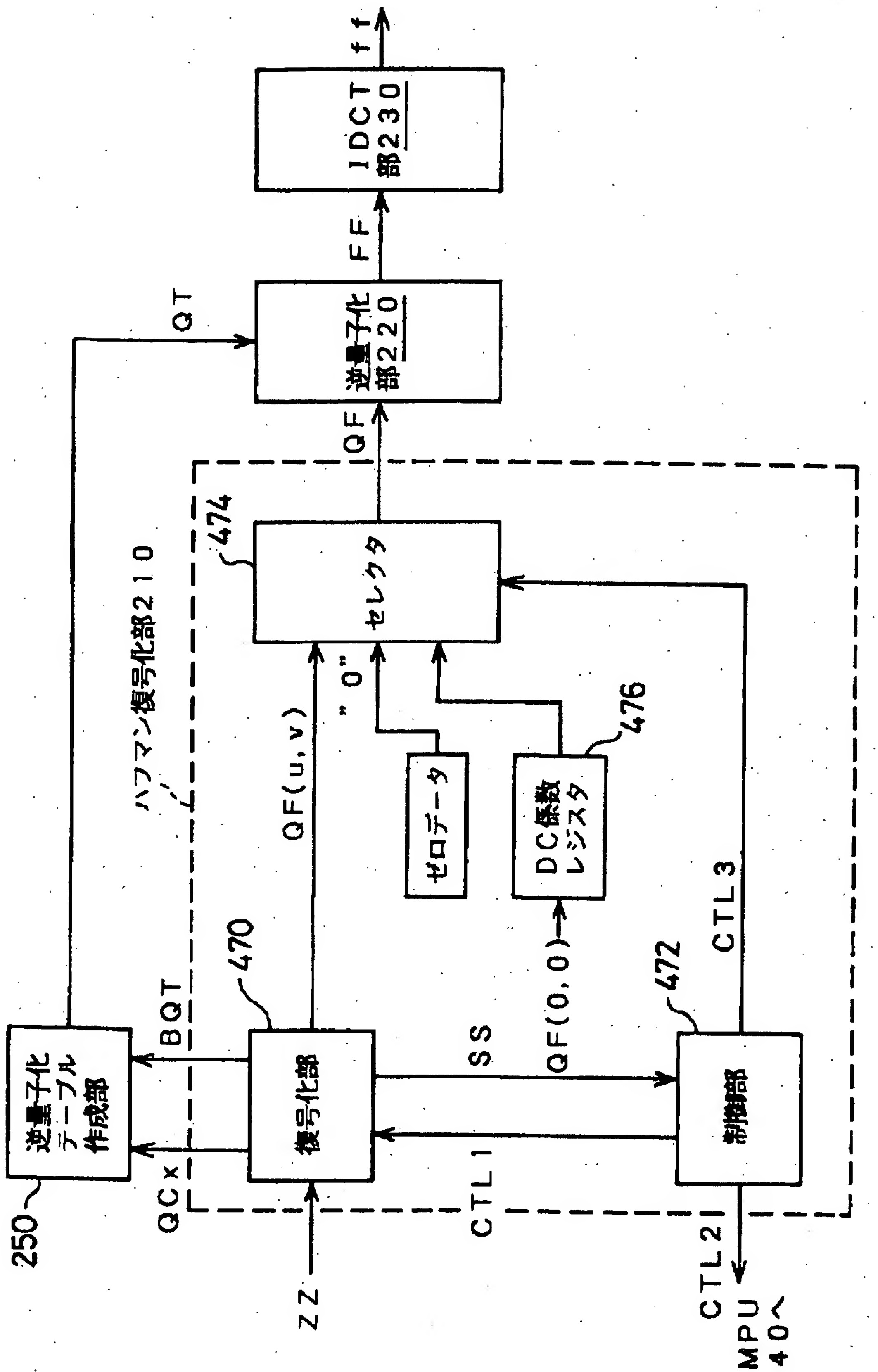
[Drawing 26]



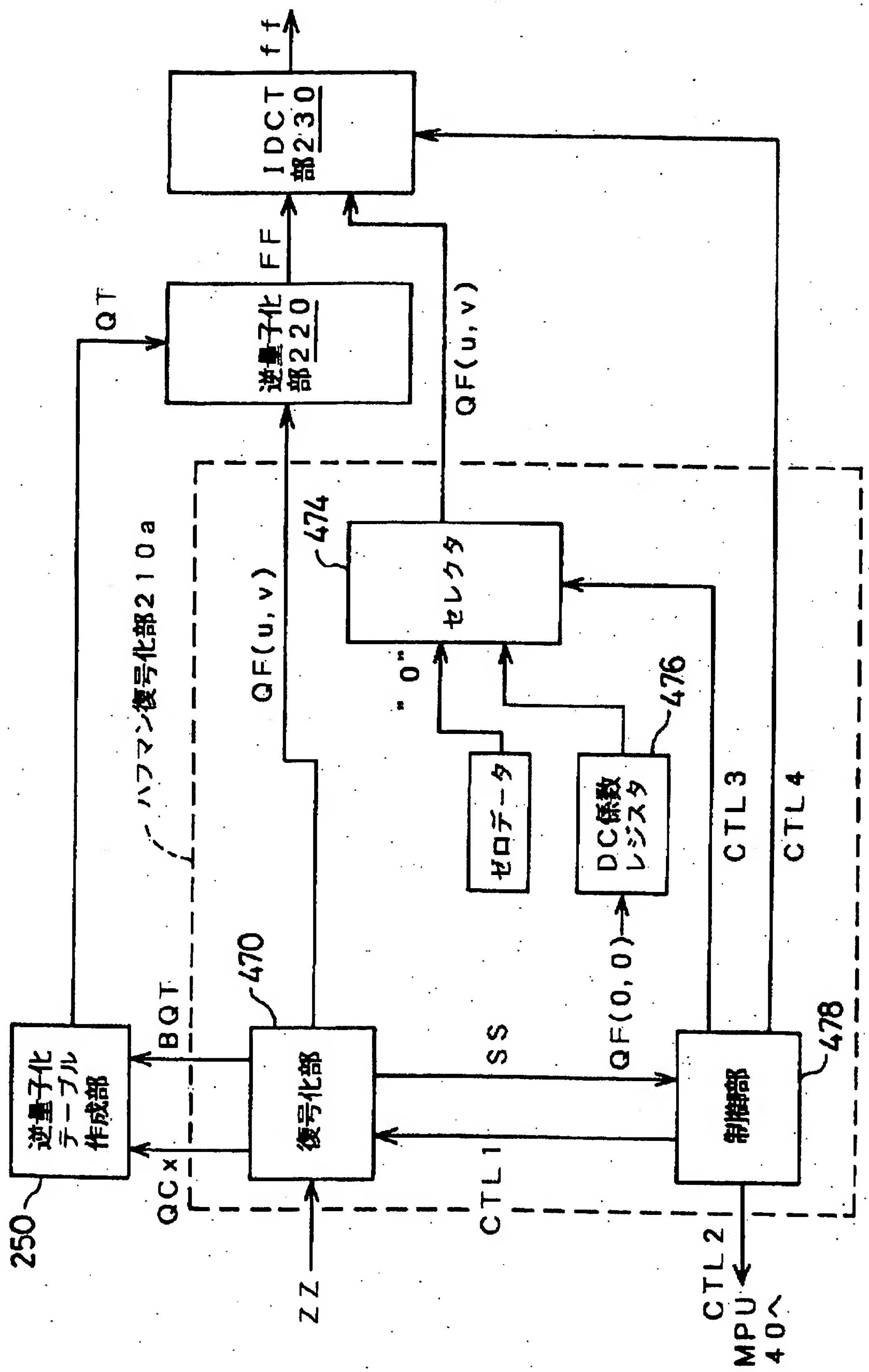
[Drawing 31]


540
542
544
546
原画像データ
直交
変換部
量子化部
エントロピー
符号化部
562
564
量子化
テーブル
符号
テーブル
圧縮画像データ
復元された
画像データ
逆直交
変換部
逆量子化部
エントロピー
復号化部
552
554
556
550

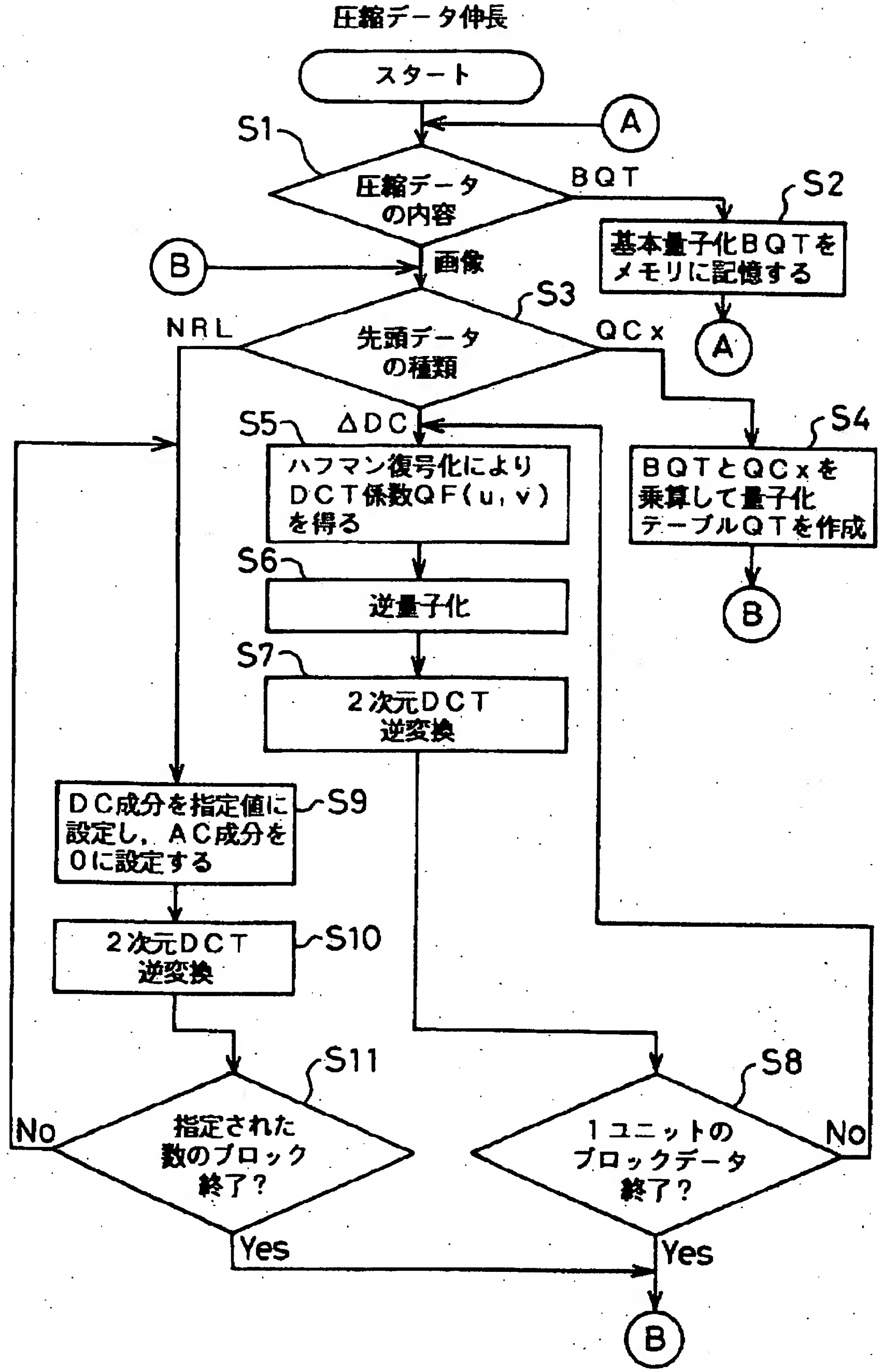
[Drawing 27]


ハフマン復号化部210
逆量子化テーブル作成部
250
復号化部
470
制御部
472
セレクタ
474
ゼロデータ
DC係数レジスタ
476
逆量子化部220
IDCT部230
QT
QF
FF
ff
BQT
QCx
ZZ
SS
QF(0,0)
QF(u,v)
"0"
CTL1
CTL2
CTL3
MPU 40へ

[Drawing 29]


ff
IDCT
部230
FF
QT
逆量子化
部220
QF(u,v)
ハフマン復号化部210a
QF(u,v)
474
セレクタ
"0"
ゼロデータ
476
DC係数
レジスタ
CTL3
CTL4
250
逆量子化
テーブル
作成部
BQT
QCx
470
復号化部
SS
QF(0,0)
CTL1
制御部
478
ZZ
CTL2
MPU
40へ

[Drawing 30]



[Translation done.]

PATENT ABSTRACTS OF JAPAN

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H03M 7/30
H03M 7/40
H04N 1/41

(21)Application number : 05-265812
(22)Date of filing : 28.09.1993

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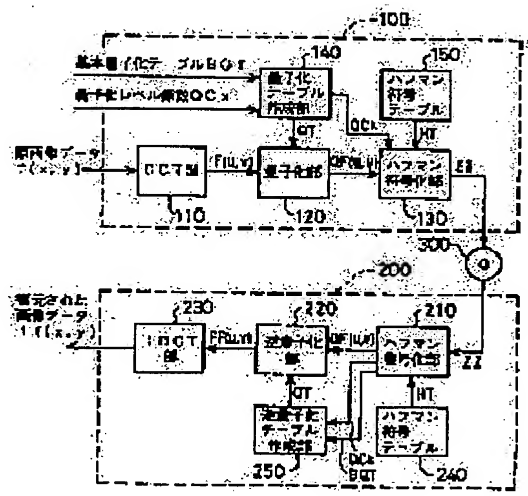
HUDSON SOFT CO LTD
(72)Inventor : MIYANE TOSHIKI
SEKIMOTO UICHI

(30)Priority

Priority number	Priority date	Priority country
04258398	28.09.1992	JP
05 66831	25.03.1993	JP

(54) METHOD AND DEVICE FOR COMPRESSING/EXTENDING IMAGE DATA

(57)Abstract:
PURPOSE: To reduce the data amount of compressed image data in comparison with the conventional data amount.
CONSTITUTION: The compressed image data contains code data showing a quantizing level coefficient QCx among block data. An inverse guantizing table preparation part 250 prepares a quantizing table QT by multiplying a DCT coefficient QF(u,v) provided by decoding compressed image data ZZ and the quantizing level coefficient QCx. An inverse quantizing part 220 performs inverse quantizing by using the quantizing table QT. Since the quantizing level coefficient QCx is inserted between the block data of the compressed image data, the quantizing table QT is updated each time the quantizing level coefficient QCx is decoded. On the other hand, data expressing plural continuous picture element blocks in the same pattern color are inserted to the compressed image data in any special data format (null run data).



LEGAL STATUS

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[Date of sending the examiner's decision of rejection]	13.01.2004
[Kind of final disposal of application other than the examiner's decision of rejection or	

application converted registration]	
[Date of final disposal for application]	
[Patent number]	3673529
[Date of registration]	28.04.2005
[Number of appeal against examiner's decision of rejection]	2004-02865
[Date of requesting appeal against examiner's decision of rejection]	12.02.2004
[Date of extinction of right]	

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Ｈ０３Ｍ　7/30	Ａ	8842－5Ｊ		
			Ｈ０４Ｎ　7/ 133	Ｚ
		8420－5Ｌ	Ｇ０６Ｆ　15/ 66	３３０　Ｈ

審査請求　未請求　請求項の数29　ＦＤ　（全 34 頁）　最終頁に続く

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(31)優先権主張番号　特願平4－258398

(32)優先日　平４(1992)９月28日

(33)優先権主張国　日本（ＪＰ）

(31)優先権主張番号　特願平5－66831

(32)優先日　平５(1993)３月25日

(33)優先権主張国　日本（ＪＰ）

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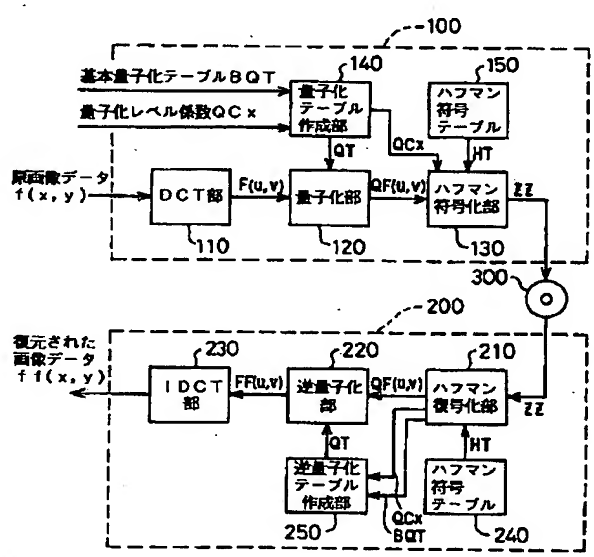
(74)代理人　弁理士　下出　隆史　（外１名）

(54)【発明の名称】　画像データの圧縮・伸長方法およびそのための装置

(57)【要約】

【目的】　圧縮画像データのデータ量を従来に比べて低減する。

【構成】　圧縮画像データは、ブロックデータの間に量子化レベル係数ＱＣｘを示す符号データを含んでいる。逆量子化テーブル作成部２５０は、圧縮画像データＺＺを復号して得られたＤＣＴ係数ＱＦ（ｕ，ｖ）と量子化レベル係数ＱＣｘを乗算することによって量子化テーブルＱＴを作成する。逆量子化部２２０は、量子化テーブルＱＴを用いて逆量子化を行なう。量子化レベル係数ＱＣｘは、圧縮画像データのブロックデータの間に挿入されているので、量子化レベル係数ＱＣｘが復号化されるたびに量子化テーブルＱＴが更新される。また、同一のパターンの色を有する連続した複数の画素ブロックを表わすデータは、特殊なデータ形式（ヌルランデータ）で圧縮画像データ中に挿入されている。



【特許請求の範囲】

【請求項１】　画像データを直交変換し、量子化し、さらにエントロピー符号化して得られた符号データを含む圧縮画像データを伸長する方法であって、

（Ａ）複数の画素ブロックに対する符号データと、前記複数の画素ブロックの先頭に位置する第１の画素ブロックに対する第１の係数コードと、任意の第２の画素ブロックに対する第２の係数コードとを含む圧縮画像データを準備する工程と、

（Ｂ）前記符号データをエントロピー復号化することによって、量子化された変換係数を生成するとともに、前記第１と第２の係数コードをエントロピー復号化することによって第１と第２の係数を生成する工程と、

（Ｃ）前記第１と第２の係数のそれぞれと、所定の基本量子化テーブルの基本量子化レベルとを乗ずることによって、第１と第２の量子化テーブルを作成する工程と、

（Ｄ）前記第１の画素ブロックに対する前記量子化された変換係数を前記第１の量子化テーブルで逆量子化するとともに、前記第２の画素ブロックに対する前記量子化された変換係数を前記第２の量子化テーブルで逆量子化することによって、逆量子化された変換係数を求める工程と、

（Ｅ）前記逆量子化された変換係数を逆直交変換することによって、伸長された画像データを求める工程と、

を備えることを特徴とする圧縮画像データの伸長方法。

【請求項２】　請求項１記載の圧縮画像データの伸長方法であって、

前記符号データは、前記複数の画素ブロックの配列順序に従って配列された複数のデータユニットを含むとともに、前記第１の画素ブロックに対する第１のデータユニットの直前に前記第１の係数コードが配置され、前記第２の画素ブロックに対する第２のデータユニットの直前に前記第２の係数コードが配置されている、圧縮画像データの伸長方法。

【請求項３】　請求項２記載の圧縮画像データの伸長方法であって、

前記第１と第２の係数コードは、前記第１と第２の係数と前記変換係数の直流成分とに対する複数のエントロピー符号語を含む符号テーブル内のエントロピー符号語である圧縮画像データの伸長方法。

【請求項４】　請求項１記載の圧縮画像データの伸長方法であって、前記工程（Ｄ）は、

前記第１の画素ブロックから、前記第２の画素ブロックの直前に配列された第３の画素ブロックまでの一連の画素ブロックに対して、前記第１の量子化テーブルを用いて逆量子化する工程、

を含む圧縮画像データの伸長方法。

【請求項５】　請求項１記載の圧縮画像データの伸長方法であって、前記工程（Ｃ）は、

前記第１と第２の係数のそれぞれと前記基本量子化テーブルに含まれている量子化レベルとの乗算結果が所定の最大値を超える場合には、前記乗算結果が前記最大値を超えた量子化レベルの値を前記最大値に等しく設定する工程、

を含む圧縮画像データの伸長方法。

【請求項６】　請求項１記載の圧縮画像データの伸長方法であって、前記工程（Ｃ）は、

前記基本量子化テーブル内の所定の基本量子化レベルについては、前記乗算を実質的に行なわずに、そのまま前記第１と第２の逆量子化テーブルの量子化レベルとする工程、

を含む圧縮画像データの伸長方法。

【請求項７】　請求項６記載の圧縮画像データの伸長方法であって、

前記所定の基本量子化レベルは、前記変換係数の直流成分に関する量子化レベルである、圧縮画像データの伸長方法。

【請求項８】　請求項１記載の圧縮画像データの伸長方法であって、

前記圧縮画像データは、さらに、同一の画像パターンを有する連続した複数の画素ブロックの個数を示す同一パターンブロックデータを含み、

さらに、前記工程（Ｂ）は、

前記同一パターンブロックデータで表わされた前記複数の画素ブロックに対する前記量子化された変換係数を作成する際に、前記変換係数の所定の成分を予め指定された値に設定するとともに、前記所定の成分以外の前記変換係数の成分の値をゼロに設定することによって作成する工程、

を有する圧縮画像データの伸長方法。

【請求項９】　請求項８記載の圧縮画像データの伸長方法であって、

前記所定の成分は直流成分である、圧縮画像データの伸長方法。

【請求項１０】　請求項８記載の圧縮画像データの伸長方法であって、

前記工程（Ｄ）は、前記同一パターンブロックデータから復号化された前記変換係数については前記逆量子化を省略する工程、

を含む圧縮画像データの伸長方法。

【請求項１１】　画像データを直交変換し、量子化し、さらにエントロピー符号化して得られた符号データを含む圧縮画像データを伸長する方法であって、

（Ａ）複数の第１の画素ブロックに対する符号データと、同一の画像パターンを有する連続した複数の第２の画素ブロックの個数を示す同一パターンブロックデータとを含む圧縮画像データを準備する工程と、

（Ｂ）前記符号データをエントロピー復号化することによって前記複数の第１の画素ブロックに対する第１の量子化された変換係数を作成するとともに、前記同一パタ

ーンブロックデータで表わされた前記複数の第２の画素ブロックに対する第２の量子化された変換係数を作成する際に、前記変換係数の所定の成分を予め指定された値に設定するとともに、前記所定の成分以外の前記変換係数の成分の値をゼロに設定することによって前記第２の量子化された変換係数を作成する工程と、
（Ｃ）前記第１と第２の量子化された変換係数を量子化テーブルを用いて逆量子化することによって、第１と第２の逆量子化された変換係数を求める工程と、
（Ｄ）前記第１と第２の逆量子化された変換係数を逆直交変換することによって、伸長された画像データを作成する工程と、
を備えることを特徴とする圧縮画像データの伸長方法。
【請求項１２】　画像データを直交変換し、量子化し、さらにエントロピー符号化して得られた符号データを含む圧縮画像データを伸長する装置であって、
複数の画素ブロックに対する符号データと、前記複数の画素ブロックの先頭に位置する第１の画素ブロックに対する第１の係数コードと、任意の第２の画素ブロックに対する第２の係数コードとを含む圧縮画像データを記憶する記憶手段と、
前記符号データをエントロピー復号化することによって、量子化された変換係数を生成するとともに、前記第１と第２の係数コードをエントロピー復号化することによって第１と第２の係数を生成するエントロピー復号化手段と、
前記第１と第２の係数のそれぞれと、所定の基本量子化テーブルの基本量子化レベルとを乗ずることによって、第１と第２の量子化テーブルを作成する逆量子化テーブル作成手段と、
前記第１の画素ブロックに対する前記量子化された変換係数を前記第１の量子化テーブルで逆量子化するとともに、前記第２の画素ブロックに対する前記量子化された変換係数を前記第２の量子化テーブルで逆量子化することによって、逆量子化された変換係数を求める逆量子化手段と、
前記逆量子化された変換係数を逆直交変換することによって、伸長された画像データを求める逆直交変換手段と、
を備えることを特徴とする圧縮画像データの伸長方法。
【請求項１３】　請求項１２記載の圧縮画像データの伸長装置であって、
前記符号データは、前記複数の画素ブロックの配列順序に従って配列された複数のデータユニットを含むとともに、前記第１の画素ブロックに対する第１のデータユニットの直前に前記第１の係数コードが配置され、前記第２の画素ブロックに対する第２のデータユニットの直前に前記第２の係数コードが配置されている、圧縮画像データの伸長装置。
【請求項１４】　請求項１３記載の圧縮画像データの伸長装置であって、
前記第１と第２の係数コードは、前記第１と第２の係数と前記変換係数の直流成分とに対する複数のエントロピー符号語を含む符号テーブル内のエントロピー符号語である圧縮画像データの伸長装置。
【請求項１５】　請求項１２記載の圧縮画像データの伸長装置であって、前記逆量子化手段は、
前記第１の画素ブロックから、前記第２の画素ブロックの直前に配列された第３の画素ブロックまでの一連の画素ブロックに対して、前記第１の量子化テーブルを用いて逆量子化する手段、
を含む圧縮画像データの伸長装置。
【請求項１６】　請求項１２記載の圧縮画像データの伸長装置であって、前記逆量子化テーブル作成手段は、
前記第１と第２の係数のそれぞれと前記基本量子化テーブルに含まれている量子化レベルとの乗算結果が所定の最大値を超える場合には、前記乗算結果が前記最大値を超えた量子化レベルの値を前記最大値に等しく設定するクリッピング手段、
を含む圧縮画像データの伸長装置。
【請求項１７】　請求項１２記載の圧縮画像データの伸長装置であって、前記逆量子化テーブル作成手段は、
前記基本量子化テーブル内の所定の基本量子化レベルについては、前記乗算を実質的に行なわずに、そのまま前記第１と第２の逆量子化テーブルの量子化レベルとする手段、
を含む圧縮画像データの伸長装置。
【請求項１８】　請求項１７記載の圧縮画像データの伸長装置であって、
前記所定の基本量子化レベルは、前記変換係数の直流成分に関する量子化レベルである、圧縮画像データの伸長装置。
【請求項１９】　請求項１２記載の圧縮画像データの伸長装置であって、
前記圧縮画像データは、同一の画像パターンを有する連続した複数の画素ブロックの個数を示す同一パターンブロックデータを含み、
さらに、前記エントロピー復号化手段は、
前記同一パターンブロックデータで表わされた前記複数の画素ブロックに対する前記量子化された変換係数を作成する際に、前記変換係数の所定の成分を予め指定された値に設定するとともに、前記所定の成分以外の前記変換係数の成分の値をゼロに設定することによって作成する手段、
を有する圧縮画像データの伸長装置。
【請求項２０】　請求項１９記載の圧縮画像データの伸長装置であって、
前記所定の成分は直流成分である、圧縮画像データの伸長装置。
【請求項２１】　請求項１９記載の圧縮画像データの伸

長装置であって、
前記エントロピー復号化手段は、前記同一パターンブロックデータから復号化された前記変換係数を、前記逆量子化手段をバイパスして前記逆直交変換手段に供給する手段、
を含む圧縮画像データの伸長装置。
【請求項２２】　画像データを直交変換し、量子化し、さらにエントロピー符号化して得られた符号データを含む圧縮画像データを伸長する装置であって、
複数の第１の画素ブロックに対する符号データと、同一の画像パターンを有する連続した複数の第２の画素ブロックの個数を示す同一パターンブロックデータとを含む圧縮画像データを記憶する第１の記憶手段と、
前記複数の第２の画素ブロックに関する変換係数の所定の成分に対する指定値を記憶する第２の記憶手段と、
前記符号データをエントロピー復号化することによって前記複数の第１の画素ブロックに対する第１の量子化された変換係数を作成するとともに、前記同一パターンブロックデータで表わされた前記複数の第２の画素ブロックに対する第２の量子化された変換係数を作成する際に、前記所定の成分を前記第２の記憶手段に記憶された指定値に設定するとともに前記所定の成分以外の前記変換係数の値をゼロに設定することによって第２の量子化された変換係数を作成するエントロピー復号化手段と、
前記第１と第２の量子化された変換係数を量子化テーブルを用いて逆量子化することによって、第１と第２の逆量子化された変換係数を求める逆量子化手段と、
前記第１と第２の逆量子化された変換係数を逆直交変換することによって、伸長された画像データを作成する逆直交変換手段と、
を備えることを特徴とする圧縮画像データの伸長装置。
【請求項２３】　画像データの圧縮方法であって、
（Ａ）画像データを画像内の複数の画素ブロック毎に直交変換して変換係数を求める工程と、
（Ｂ）前記複数の画素ブロックの先頭に位置する第１の画素ブロックに対する第１の係数と、任意の第２の画素ブロックに対する第２の係数とを指定する工程と、
（Ｃ）前記第１と第２の係数のそれぞれと所定の基本量子化テーブルの基本量子化レベルとを乗ずることによって、第１と第２の量子化テーブルを作成する工程と、
（Ｄ）前記第１と第２の画素ブロックに対する前記変換係数を前記第１と第２の量子化テーブルでそれぞれ量子化することによって、量子化された変換係数を求める工程と、
（Ｅ）前記量子化された変換係数をエントロピー符号化することによって符号データを作成するとともに、前記第１と第２の係数をエントロピー符号化することによって第１と第２の係数コードを作成する工程と、
（Ｆ）前記符号データと前記第１と第２の係数コードとを含む圧縮画像データを作成する工程と、
を備えることを特徴とする画像データの圧縮方法。
【請求項２４】　請求項２３記載の画像データの圧縮方法であって、
前記符号データは、前記複数の画素ブロックの配列順序に従って配列された複数のデータユニットを含むとともに、前記第１の画素ブロックに対する第１のデータユニットの直前に前記第１の係数コードを含み、前記第２の画素ブロックに対する第２のデータユニットの直前に前記第２の係数コードを含む、
画像データの圧縮方法。
【請求項２５】　請求項２４記載の画像データの圧縮方法であって、前記工程（Ｅ）は、
前記第１と第２の係数と前記変換係数の直流成分とに対する複数のエントロピー符号語を含む符号テーブルを用いて、前記第１と第２の係数をエントロピー符号化する工程、
を含む画像データの圧縮方法。
【請求項２６】　請求項２３記載の画像データの圧縮方法であって、前記工程（Ｅ）は、同一の画像パターンを有する連続した複数の画素ブロックの個数を示す同一パターンブロックデータを作成する工程を含み、
前記工程（Ｆ）は、前記符号データおよび前記第１と第２の係数コードとともに、前記同一パターンブロックデータを含む圧縮画像データを作成する工程を含む画像データの圧縮方法。
【請求項２７】　画像データを直交変換し、量子化し、さらにエントロピー符号化して得られた符号データを含む圧縮画像データを伸長する方法であって、
（Ａ）複数の画素ブロックに対する符号データと、前記複数の画素ブロックのうちの任意の第１の画素ブロックに対する第１の係数コードとを含む圧縮画像データを準備する工程と、
（Ｂ）前記符号データをエントロピー復号化することによって、量子化された変換係数を生成するとともに、前記第１の係数コードをエントロピー復号化することによって第１の係数を生成する工程と、
（Ｃ）前記第１の係数と、所定の基本量子化テーブルの基本量子化レベルとを乗ずることによって、第１の量子化テーブルを作成する工程と、
（Ｄ）前記第１の画素ブロックを含む少なくとも１つの画素ブロックに対する前記量子化された変換係数を前記第１の量子化テーブルで逆量子化することによって、逆量子化された変換係数を求める工程と、
（Ｅ）前記逆量子化された変換係数を逆直交変換することによって、伸長された画像データを求める工程と、
を備えることを特徴とする圧縮画像データの伸長方法。
【請求項２８】　請求項２７記載の圧縮画像データの伸長方法であって、
前記圧縮画像データは、さらに、前記第１の画素ブロック以降に配列された第２の画素ブロックに対する第２の

係数コードを含み、
前記工程（Ｂ）は、前記第２の係数コードをエントロピー復号化することによって第２の係数を生成する工程を含み、
前記工程（Ｃ）は、前記第２の係数と前記基本量子化テーブルの基本量子化レベルとを乗ずることによって、第２の量子化テーブルを作成する工程を含み、
前記工程（Ｄ）は、前記第１の画素ブロックから前記第２の画素ブロックの直前に配列された第３の画素ブロックまでの一連の画素ブロックに対する前記量子化された変換係数を、前記第１の量子化テーブルを用いて逆量子化するとともに、前記第２の画素ブロックを含む少なくとも１つの画素ブロックに対する前記量子化された変換係数を前記第２の量子化テーブルで逆量子化する工程、を含む圧縮画像データの伸長方法。
【請求項２９】　請求項２８記載の圧縮画像データの伸長方法であって、
前記符号データは、前記複数の画素ブロックの配列順序に従って配列された複数のデータユニットを含むとともに、前記第１の画素ブロックに対する第１のデータユニットの直前に前記第１の係数コードが配置され、前記第２の画素ブロックに対する第２のデータユニットの直前に前記第２の係数コードが配置されている、圧縮画像データの伸長方法。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】この発明は、画像データを圧縮・伸長する方法およびそのための装置に関する。
【０００２】
【従来の技術】図３１は、従来の画像データの圧縮／伸長装置の構成を示すブロック図である。画像データ圧縮装置５４０は、直交変換部５４２において原画像データをM×N画素のブロック毎に直交変換した後、量子化部５４４において量子化を行ない、さらに、エントロピー符号化部５４６において符号化を行なって圧縮画像データを作成する。一方、画像データ伸長装置５５０は、まずエントロピー復号化部５５６において圧縮画像データを復号化し、逆量子化部５５４で逆量子化した後に、逆直交変換部５５２によって画像データを復元する。なお、量子化部５４４と逆量子化部５５４は同一の量子化テーブル５６２を使用し、また、エントロピー符号化部５４６とエントロピー復号化部５５６も同一の符号テーブル５６４を使用する。
【０００３】
【発明が解決しようとする課題】ところで、１つの画像内に、高画質で復元したい第１の部分と低画質で復元してもよい第２の部分とを含む場合がある。このような場合には、第１の部分に対しては量子化レベルの小さな量子化テーブルを用いて量子化を行ない、第２の部分に対しては量子化レベルの大きな量子化テーブルを用いて量子化を行なえば良い。量子化テーブルは、画像データの画素ブロックと同じサイズの行列、すなわちM行N列の行列である。従来の画像データ圧縮／伸長装置では、１つの画像内において複数の量子化テーブルを使用する場合には、M行N列の複数の量子化テーブルを圧縮装置５４０から伸長装置５５０に転送しなければならず、圧縮画像データのデータ量を増大させるという問題があった。
【０００４】また、画像の中に一様な色を有する画素ブロックが連続するような単純な画像部分についても、それらの画素ブロックに対するM行N列の直交変換係数をすべてエントロピー符号化する。従って、このような単純な画像部分を表わす圧縮画像データも、かなりのデータ量になるという問題があった。
【０００５】この発明は、従来技術における上述の課題を解決するためになされたものであり、圧縮画像データのデータ量を従来に比べて低減することのできる技術を提供することを目的とする。
【０００６】
【課題を解決するための手段および作用】上述の課題を解決するため、この発明による圧縮画像データ伸長方法は、（Ａ）複数の画素ブロックに対する符号データと、前記複数の画素ブロックの先頭に位置する第１の画素ブロックに対する第１の係数コードと、任意の第２の画素ブロックに対する第２の係数コードとを含む圧縮画像データを準備する工程と、（Ｂ）前記符号データをエントロピー復号化することによって、量子化された変換係数を生成するとともに、前記第１と第２の係数コードをエントロピー復号化することによって第１と第２の係数を生成する工程と、（Ｃ）前記第１と第２の係数のそれぞれと、所定の基本量子化テーブルの基本量子化レベルとを乗ずることによって、第１と第２の量子化テーブルを作成する工程と、（Ｄ）前記第１の画素ブロックに対する前記量子化された変換係数を前記第１の量子化テーブルで逆量子化するとともに、前記第２の画素ブロックに対する前記量子化された変換係数を前記第２の量子化テーブルで逆量子化することによって、逆量子化された変換係数を求める工程と、（Ｅ）前記逆量子化された変換係数を逆直交変換することによって、伸長された画像データを求める工程と、を備える。
【０００７】第１と第２の係数を与えるだけで量子化レベルの異なる第１と第２の量子化テーブルを作成できるので、２つの量子化テーブルを圧縮画像データに含める場合に比べて圧縮画像データのデータ量を低減することができる。
【０００８】前記符号データは、前記複数の画素ブロックの配列順序に従って配列された複数のデータユニットを含むとともに、前記第１の画素ブロックに対する第１のデータユニットの直前に前記第１の係数コードが配置され、前記第２の画素ブロックに対する第２のデータユ

ニットの直前に前記第２の係数コードが配置されているようにしてもよい。

【０００９】こうすれば、第１と第２の係数を第１と第２の画素ブロックにそれぞれ容易に対応づけられる。

【００１０】また、前記第１と第２の係数コードは、前記第１と第２の係数と前記変換係数の直流成分とに対する複数のエントロピー符号語を含む符号テーブル内のエントロピー符号語であることが好ましい。

【００１１】こうすれば、第１と第２の係数を一意にかつ瞬時に復号することができる。

【００１２】前記工程（Ｄ）は、前記第１の画素ブロックから、前記第２の画素ブロックの直前に配列された第３の画素ブロックまでの一連の画素ブロックに対して、前記第１の量子化テーブルを用いて逆量子化する工程、を含むようにするのが好ましい。

【００１３】第２の係数が現われるまでの複数の画素ブロックに対して第１の係数が適用されるので、これらの複数の画素ブロックのそれぞれの符号データの前に第１の係数を含めておく必要がない。

【００１４】前記工程（Ｃ）は、前記第１と第２の係数のそれぞれと前記基本量子化テーブルに含まれている量子化レベルとの乗算結果が所定の最大値を超える場合には、前記乗算結果が前記最大値を超えた量子化レベルの値を前記最大値に等しく設定する工程、を含むようにしてもよい。

【００１５】こうすれば、量子化レベルのビット数を一定値以下に保つことができる。

【００１６】前記工程（Ｃ）は、前記基本量子化テーブル内の所定の基本量子化レベルについては、前記乗算を実質的に行なわずに、そのまま前記第１と第２の逆量子化テーブルの量子化レベルとする工程、を含むようにしてもよい。

【００１７】こうすれば、所定の位置の変換係数を逆量子化する際に発生する誤差を低減することができる。

【００１８】前記所定の基本量子化レベルは、前記変換係数の直流成分に関する量子化レベルであるようにするのが好ましい。

【００１９】変換係数の直流成分に対する量子化レベルを変えないようにすれば、直流成分の逆量子化にともなう誤差を低減することができる。

【００２０】前記圧縮画像データは、さらに、同一の画像パターンを有する連続した複数の画素ブロックの個数を示す同一パターンブロックデータを含み、さらに、前記工程（Ｂ）は、前記同一パターンブロックデータで表わされた前記複数の画素ブロックに対する前記量子化された変換係数を作成する際に、前記変換係数の所定の成分を予め指定された値に設定するとともに、前記所定の成分以外の前記変換係数の成分の値をゼロに設定することによって作成する工程、を有するようにしてもよい。

【００２１】こうすれば、互いに同一の画像パターンを有する連続した複数の画素ブロックを比較的少ないデータで表わすことができる。

【００２２】前記所定の成分は直流成分であることが好ましい。

【００２３】こうすれば、連続した複数の画素ブロックを同一の色で塗ることができる。

【００２４】前記工程（Ｄ）は、前記同一パターンブロックデータから復号化された前記変換係数については前記逆量子化を省略する工程、を含むようにしてもよい。

【００２５】こうすれば、逆量子化による誤差の発生を防止することができる。

【００２６】この発明による他の圧縮画像データ伸長方法は、（Ａ）複数の第１の画素ブロックに対する符号データと、同一の画像パターンを有する連続した複数の第２の画素ブロックの個数を示す同一パターンブロックデータとを含む圧縮画像データを準備する工程と、（Ｂ）前記符号データをエントロピー復号化することによって前記複数の第１の画素ブロックに対する第１の量子化された変換係数を作成するとともに、前記同一パターンブロックデータで表わされた前記複数の第２の画素ブロックに対する第２の量子化された変換係数を作成する際に、前記変換係数の所定の成分を予め指定された値に設定するとともに、前記所定の成分以外の前記変換係数の成分の値をゼロに設定することによって前記第２の量子化された変換係数を作成する工程と、（Ｃ）前記第１と第２の量子化された変換係数を量子化テーブルを用いて逆量子化することによって、第１と第２の逆量子化された変換係数を求める工程と、（Ｄ）前記第１と第２の逆量子化された変換係数を逆直交変換することによって、伸長された画像データを作成する工程とを備える。

【００２７】この方法では、互いに同一のパターンの色を有する連続した複数の画素ブロックを比較的少ないデータで表わすことができる。

【００２８】この発明による圧縮画像データ伸長装置は、複数の画素ブロックに対する符号データと、前記複数の画素ブロックの先頭に位置する第１の画素ブロックに対する第１の係数コードと、任意の第２の画素ブロックに対する第２の係数コードとを含む圧縮画像データを記憶する記憶手段と、前記符号データをエントロピー復号化することによって、量子化された変換係数を生成するとともに、前記第１と第２の係数コードをエントロピー復号化することによって第１と第２の係数を生成するエントロピー復号化手段と、前記第１と第２の係数のそれぞれと、所定の基本量子化テーブルの基本量子化レベルとを乗ずることによって、第１と第２の量子化テーブルを作成する逆量子化テーブル作成手段と、前記第１の画素ブロックに対する前記量子化された変換係数を前記第１の量子化テーブルで逆量子化するとともに、前記第２の画素ブロックに対する前記量子化された変換係数を前記第２の量子化テーブルで逆量子化することによっ

て、逆量子化された変換係数を求める逆量子化手段と、前記逆量子化された変換係数を逆直交変換することによって、伸長された画像データを求める逆直交変換手段と、を備える。

【0029】また、この発明による他の圧縮画像データ伸長装置は、複数の第1の画素ブロックに対する符号データと、同一の画像パターンを有する連続した複数の第2の画素ブロックの個数を示す同一パターンブロックデータとを含む圧縮画像データを記憶する第1の記憶手段と、前記複数の第2の画素ブロックに関する変換係数の所定の成分に対する指定値を記憶する第2の記憶手段と、前記符号データをエントロピー復号化することによって前記複数の第1の画素ブロックに対する第1の量子化された変換係数を作成するとともに、前記同一パターンブロックデータで表わされた前記複数の第2の画素ブロックに対する第2の量子化された変換係数を作成する際に、前記所定の成分を前記第2の記憶手段に記憶された指定値に設定するとともに前記所定の成分以外の前記変換係数の値をゼロに設定することによって第2の量子化された変換係数を作成するエントロピー復号化手段と、前記第1と第2の量子化された変換係数を量子化テーブルを用いて逆量子化することによって、第1と第2の逆量子化された変換係数を求める逆量子化手段と、前記第1と第2の逆量子化された変換係数を逆直交変換することによって、伸長された画像データを作成する逆直交変換手段と、を備える。

【0030】この発明による画像データの圧縮方法は、（A）画像データを画像内の複数の画素ブロック毎に直交変換して変換係数を求める工程と、（B）前記複数の画素ブロックの先頭に位置する第1の画素ブロックに対する第1の係数と、任意の第2の画素ブロックに対する第2の係数とを指定する工程と、（C）前記第1と第2の係数のそれぞれと所定の基本量子化テーブルの基本量子化レベルとを乗ずることによって、第1と第2の量子化テーブルを作成する工程と、（D）前記第1と第2の画素ブロックに対する前記変換係数を前記第1と第2の量子化テーブルでそれぞれ量子化することによって、量子化された変換係数を求める工程と、（E）前記量子化された変換係数をエントロピー符号化することによって符号データを作成するとともに、前記第1と第2の係数をエントロピー符号化することによって第1と第2の係数コードを作成する工程と、（F）前記符号データと前記第1と第2の係数コードとを含む圧縮画像データを作成する工程とを備える。

【0031】第1と第2の係数を与えるだけで量子化レベルの異なる第1と第2の量子化テーブルを作成できるので、2つの量子化テーブルを圧縮画像データに含める場合に比べて圧縮画像データのデータ量を低減することができる。

【0032】この発明によるさらに他の圧縮画像データを伸長する方法は、（A）複数の画素ブロックに対する符号データと、前記複数の画素ブロックのうちの任意の第1の画素ブロックに対する第1の係数コードとを含む圧縮画像データを準備する工程と、（B）前記符号データをエントロピー復号化することによって、量子化された変換係数を生成するとともに、前記第1の係数コードをエントロピー復号化することによって第1の係数を生成する工程と、（C）前記第1の係数と、所定の基本量子化テーブルの基本量子化レベルとを乗ずることによって、第1の量子化テーブルを作成する工程と、（D）前記第1の画素ブロックを含む少なくとも1つの画素ブロックに対する前記量子化された変換係数を前記第1の量子化テーブルで逆量子化することによって、逆量子化された変換係数を求める工程と、（E）前記逆量子化された変換係数を逆直交変換することによって、伸長された画像データを求める工程と、を備える。

【0033】こうすれば、第1と第2の係数を与えるだけで量子化レベルの異なる第1と第2の量子化テーブルを作成できるので、2つの量子化テーブルを圧縮画像データに含める場合に比べて圧縮画像データのデータ量を低減することができる

【0034】前記圧縮画像データは、さらに、前記第1の画素ブロック以降に配列された第2の画素ブロックに対する第2の係数コードを含み、前記工程（B）は、前記第2の係数コードをエントロピー復号化することによって第2の係数を生成する工程を含み、前記工程（C）は、前記第2の係数と前記基本量子化テーブルの基本量子化レベルとを乗ずることによって、第2の量子化テーブルを作成する工程を含み、前記工程（D）は、前記第1の画素ブロックから前記第2の画素ブロックの直前に配列された第3の画素ブロックまでの一連の画素ブロックに対する前記量子化された変換係数を、前記第1の量子化テーブルを用いて逆量子化するとともに、前記第2の画素ブロックを含む少なくとも1つの画素ブロックに対する前記量子化された変換係数を前記第2の量子化テーブルで逆量子化する工程、を含むようにするのが好ましい。

【0035】こうすれば、圧縮画像データに第1と第2の係数コードを含めておくだけで、圧縮画像データの伸長時に、2つの量子化テーブルを用いて量子化を行なうことができる。

【0036】

【実施例】以下では、次の各項目について順次説明を行なう。

A．圧縮／伸長装置の全体構成と基本動作；

B．量子化レベル係数ＱＣｘによる量子化テーブルＱＴの調整；

C．ハフマン符号化と圧縮データの構成；

D．逆量子化テーブル作成部の詳細構成；

E．ヌルランデータの復号化

【００３７】Ａ．圧縮／伸長装置の構成と動作：図１は、この発明の一実施例を適用した画像データの圧縮装置１００と伸長装置２００の機能を示すブロック図である。

【００３８】画像データ圧縮装置１００は、原画像データｆ（ｘ，ｙ）に対してディスクリートコサイン変換を行なうＤＣＴ部１１０と、ＤＣＴ変換で得られた変換係数Ｆ（ｕ，ｖ）を量子化する量子化部１２０と、量子化された変換係数ＱＦ（ｕ，ｖ）をハフマン符号化して圧縮画像データＺＺを作成するハフマン符号化部１３０と、量子化テーブル作成部１４０と、ハフマン符号テーブルメモリ１５０とを備えている。量子化テーブル作成部１４０は、後述するように、基本量子化テーブルＢＱＴと量子化レベル係数ＱＣｘとに基づいて量子化テーブルＱＴを作成する。圧縮画像データＺＺは、ＣＤ－ＲＯＭなどの記憶媒体に記憶されて、画像データ圧縮装置１００から画像データ伸長装置２００に供給される。

【００３９】画像データ伸長装置２００は、圧縮画像データＺＺをハフマン復号化するハフマン復号化部２１０と、復号された量子化後の変換係数ＱＦ（ｕ，ｖ）を逆量子化する逆量子化部２２０と、逆量子化された変換係数ＦＦ（ｕ，ｖ）にディスクリートコサイン逆変換を行なって画像データｆｆ（ｘ，ｙ）を得るＩＤＣＴ部２３０と、ハフマン符号テーブルメモリ２４０と、逆量子化テーブル作成部２５０とを備えている。逆量子化テーブル作成部２５０は、圧縮画像データＺＺから復号された基本量子化テーブルＢＱＴと量子化レベル係数ＱＣｘとをハフマン復号化部２１０から受取り、これらに基づいて量子化テーブルＱＴを作成する。この量子化テーブルＱＴは、圧縮装置１００で用いられた量子化テーブルＱＴと同じである。また、ハフマン符号テーブルメモリ２４０に記憶されているハフマン符号テーブルＨＴも圧縮装置１００のハフマン符号テーブルメモリ１５０に記憶されているものと同じである。

【００４０】図２は、画像データ圧縮装置１００の具体的な構成を示すブロック図である。この画像データ圧縮装置１００は、ＣＰＵ１０１と、メインメモリ１０２と、キーボード１０３と、マウス１０４と、磁気ディスク装置１０５と、光磁気ディスク装置１０６とを備えている。図１に示す画像データ圧縮装置１００の各処理部１１０～１４０は、メインメモリ１０２に記憶されたソフトウェアプログラムによって実現されている。また、基本量子化テーブルＢＱＴとハフマン符号テーブルＨＴは、磁気ディスク装置１０５に記憶されている。この画像データ圧縮装置１００は、ビデオゲームを作成するためのワークステーションであり、画像データ圧縮のためのソフトウェアプログラムの他に、ビデオゲームを作成するための各種のプログラムがＣＰＵ１０１により実行される。完成したゲームプログラムは、圧縮画像データとともに光磁気ディスク装置１０６に格納される。そして、この光磁気ディスクを用いて、ビデオゲームのプログラムと圧縮画像データを含むＣＤ－ＲＯＭが製作される。

【００４１】図３は、画像データ伸長装置２００を含むビデオゲーム装置２０の構成を示すブロック図である。このビデオゲーム装置２０は、ＳＣＳＩバス３６を介して接続されたＣＤ－ＲＯＭドライブ３２の他、画像処理とこれに関する総ての処理を統括的に司るマイクロプロセッサ（以下、ＭＰＵという）４０と、このＭＰＵ４０に直接接続されたメインメモリ（以下、Ｍ－ＲＡＭと呼ぶ）４１と、同じくＢＩＯＳプログラムを記憶したＲＯＭ４２と、ＭＰＵ４０のバス（Ｍ－ＢＵＳ）４３に接続された各種ユニット、即ち画像信号コントロールユニット４５、画像データ伸長ユニット２００、特定の画像信号を出力するＶＤＰユニット４９、ビデオ信号の合成と出力を行なうビデオエンコーダユニット５０、音声データを扱う音声データ出力ユニット５２とを備える。

【００４２】また、このビデオゲーム装置２０内には、画像信号コントロールユニット４５のローカルバス（Ｋ－ＢＵＳ）５４に接続されたメモリ（以下、Ｋ－ＲＡＭと呼ぶ）５５、画像データ伸長ユニット２００のローカルバスに接続されたメモリ（以下、Ｒ－ＲＡＭと呼ぶ）２５１、ＶＤＰユニット４９のローカルバスに接続されたビデオメモリ（以下、Ｖ－ＲＡＭと呼ぶ）５９、ビデオエンコーダユニット５０からの出力信号を通常の映像信号（ＮＴＳＣ）に変換し、カラーテレビ２８に出力するＮＴＳＣコンバータ６０が備えられている。

【００４３】画像信号コントロールユニット４５，画像データ伸長ユニット２００，ビデオエンコーダユニット５０および音声データ出力ユニット５２は、それぞれロジック回路により構成されている。

【００４４】図４（Ａ）は、ゲームの背景画像となる原画像の一例を示す平面図である。この原画像は、一様な色で塗られた背景ＢＧに火山の自然画がはめ込まれた画像である。図４（Ｂ）は、１つの画素ブロックＰＢを含む原画像の一部を拡大して示している。一般に、画素ブロックＰＢは、Ｍ×Ｎ個の画素ＰＸを含むように設定できる。２つの整数Ｍ，Ｎの値としては８または１６が好ましく、この実施例では、Ｍ＝Ｎ＝８である。なお、整数ＭとＮを異なる値に設定しても良い。後述するように、圧縮画像データＺＺの中で背景ＢＧを表わすデータ部分は、一様色の画素ブロックＰＢが連続することを示す特別なデータ形式（ヌルランデータ）を有している。

【００４５】画像データ圧縮装置１００のＤＣＴ部１１０は、次の数式１に従って、各画素ブロックＰＢ毎に２次元ＤＣＴ変換を行なう。

【数１】

$$F(u,v) = \frac{1}{4} C(u)C(v) \sum_{x=0}^{7} \sum_{y=0}^{7} f(x,y) \cos\frac{\pi(2x+1)u}{16} \cos\frac{\pi(2y+1)v}{16}$$

$$C(u),\ C(v) = \frac{1}{\sqrt{2}} \quad (u,\ v = 0 \text{ の時})$$

$$= 1 \quad (u,\ v \neq 0 \text{ の時})$$

ここで、ｆ（ｘ，ｙ）は１つの画素ブロックＰＢに含まれる８×８個の画像データの配列、ｘ，ｙは各画素ブロックＰＢ内の各画素の位置を示す座標、Ｆ（ｕ，ｖ）は変換係数の配列、ｕ，ｖは周波数空間の座標である。

【００４６】図５は、変換係数Ｆ（ｕ，ｖ）の配列を示す説明図である。変換係数Ｆ（ｕ，ｖ）は画素ブロックＰＢと同じ８×８の配列である。左上端の変換係数Ｆ（０，０）はＤＣ成分（またはＤＣ係数）と呼ばれており、その他の変換係数はＡＣ成分（またはＡＣ係数）と呼ばれている。ＤＣ成分は、画素ブロックＰＢにおける画像データの平均値を示している。また、ＡＣ成分は、画素ブロックＰＢ内における画像データの変化を示している。隣接する画素の画像データにはある程度の相関があるので、ＡＣ係数の中で低周波成分の値は比較的大きく、高周波成分の値は比較的小さい。また、高周波成分が画質に与える影響は比較的小さい。

【００４７】図６は、画像データ圧縮装置１００と画像データ伸長装置２００の基本動作を示す説明図である。ＤＣＴ部１１０は、図６（ａ）に示すＤＣＴ係数Ｆ（ｕ，ｖ）を作成する。

【００４８】量子化テーブル作成部１４０は、次の数式２に示すように、基本量子化テーブルＢＱＴ（図６（ｃ））と量子化レベル係数ＱＣｘとを乗ずることによって量子化テーブルＱＴ（図６（ｄ））を作成する。

【数２】

$$QT(u,v) = QCx \times BQT(u,v)$$

【００４９】図６の例ではＱＣｘ＝１なので、量子化テーブルＱＴは基本量子化テーブルＢＱＴと同一である。

【００５０】量子化部１２０は、ＤＣＴ係数Ｆ（ｕ，ｖ）を量子化テーブルＱＴで線形量子化することによって、図６（ｂ）に示す量子化されたＤＣＴ係数ＱＦ（ｕ，ｖ）を求める。線形量子化とは、除算を行なって、その除算結果を整数に丸める処理である。

【００５１】ハフマン符号化部１３０は、このＤＣＴ係数ＱＦ（ｕ，ｖ）をハフマン符号化することによって圧縮画像データＺＺ（図６（ｅ））を作成する。なお、ハフマン符号化の方法については更に後述する。圧縮画像データＺＺは、後述するように、基本量子化テーブルＢＱＴを表わす第１のデータと、量子化レベル係数ＱＣｘと変換係数ＱＦ（ｕ，ｖ）を表わす第２のデータとを含んでいる。

【００５２】圧縮画像データＺＺが画像データ伸長装置２００に与えられると、ハフマン復号化部２１０が圧縮画像データＺＺを復号化してＤＣＴ係数ＱＦ（ｕ，ｖ）（図６（ｆ））を求める。ハフマン符号化は可逆符号化なので、このＤＣＴ係数ＱＦ（ｕ，ｖ）は、画像データ圧縮装置１００の量子化部１２０によって求められた量子化後のＤＣＴ係数ＱＦ（ｕ，ｖ）（図６（ｂ））と同一である。なお、ハフマン復号化部２１０は、ＤＣＴ係数ＱＦ（ｕ，ｖ）の他に、圧縮画像データＺＺに含まれている基本量子化テーブルＢＱＴ（図６（ｃ））と量子化レベル係数ＱＣｘも復号化して逆量子化テーブル作成部２５０に与える。

【００５３】逆量子化テーブル作成部２５０は、基本量子化テーブルＢＱＴと量子化レベル係数ＱＣｘとを乗算することによって量子化テーブルＱＴ（図６（ｄ））を作成する。逆量子化部２２０は、この量子化テーブルＱＴとＤＣＴ係数ＱＦ（ｕ，ｖ）とを乗算し、図６（ｇ）に示す復号されたＤＣＴ係数ＦＦ（ｕ，ｖ）を求める。

【００５４】ＩＤＣＴ部２３０は、このＤＣＴ係数ＦＦ（ｕ，ｖ）に対して次の数式３に示す２次元ＤＣＴ逆変換を行ない、復元された画像データｆｆ（ｘ，ｙ）を作成する。

【数３】

$$ff(x,y) = \frac{1}{4} \sum_{u=0}^{7} \sum_{v=0}^{7} C(u)C(v)\,FF(u,v) \cos\frac{\pi(2x+1)u}{16} \cos\frac{\pi(2y+1)v}{16}$$

$$C(u),\ C(v) = \frac{1}{\sqrt{2}} \quad (u,\ v = 0 \text{ の時})$$

$$= 1 \quad (u,\ v \neq 0 \text{ の時})$$

【００５５】Ｂ．量子化レベル係数ＱＣｘによる量子化テーブルＱＴの調整：量子化テーブルＱＴは、前記数式２に従って基本量子化テーブルＢＱＴと量子化レベル係数ＱＣｘとを乗算することによって作成されるので、量子化レベル係数ＱＣｘの値を大きくすれば量子化テーブルＱＴ内の各量子化レベルを大きくすることができる。量子化レベル係数ＱＣｘの値は、画像データ圧縮装置１００において画像データを圧縮する際に、予め定められた複数の値（０～１５）の中からオペレータが選択する。

【００５６】図７は、量子化レベル係数ＱＣｘを４に指定した場合の圧縮／伸長動作を示す説明図である。量子

化テーブル作成部１４０と逆量子化テーブル作成部２５０は、上記の数式２に従って、図７（ｄ）に示す量子化テーブルＱＴを作成する。但し、この実施例では量子化レベルの最大値が１５に制限されており、乗算の結果が１５以上になる量子化レベルの値はすべて強制的に１５に設定される。

【００５７】図７（ｄ）に示す量子化テーブルＱＴを用いて図７（ａ）のＤＣＴ係数Ｆ（ｕ，ｖ）を線形量子化すると、図７（ｂ）に示すように、ＤＣ成分が１であり、ＡＣ成分がすべて０であるＤＣＴ係数ＱＦ（ｕ，ｖ）が得られる。このように、量子化レベル係数ＱＣｘの値を大きくすると、量子化されたＤＣＴ係数ＱＦ（ｕ，ｖ）における０の数が増加するので、データ圧縮率を高めることができる。但し、図７（ｇ）に示す復号されたＤＣＴ係数ＦＦ（ｕ，ｖ）は、図７（ａ）に示す元のＤＣＴ係数Ｆ（ｕ，ｖ）とかなり異なる値を示しているので、量子化レベル係数ＱＣｘが１に等しい場合（図６）よりも画質の劣化は大きい。

【００５８】ところで、ＤＣＴ係数のＤＣ成分は画素ブロックＰＢ内における画像データの平均値を示しているので、画質に対する影響がかなり大きい。従って、量子化レベル係数ＱＣｘの値に係わらずに、ＤＣ成分用の量子化レベルを基本量子化テーブルＢＱＴにおける値と同じに保つようにするのが好ましい。図８は、このような場合の処理を示す説明図であり、ＤＣ成分用の量子化レベルＱＴ（０，０）が強制的に１に保たれている。ＱＴ（０，０）＝１の場合には、図８（ｇ）に示す復号されたＤＣＴ係数ＦＦ（ｕ，ｖ）のＤＣ成分が、図８（ａ）に示す元のＤＣＴ係数Ｆ（ｕ，ｖ）のＤＣ成分と同じ値に保たれるので、図７の場合と同程度の圧縮率で画質の劣化を比較的小さく抑えることができる。なお、ＤＣ成分用の量子化レベルＱＴ（０，０）は必ずしも１にする必要はなく、他の任意の値を設定しておいてもよい。

【００５９】量子化レベル係数ＱＣｘとしては０を選択することも可能である。ＱＣｘ＝０の場合には、図９に示すように、量子化テーブルＱＴ内のすべての量子化レベルが１に設定される。量子化されたＤＣＴ係数ＱＦ（ｕ，ｖ）は元のＤＣＴ係数Ｆ（ｕ，ｖ）と同じであるので、圧縮率は小さいが高画質で圧縮／伸長を行なうことができる。

【００６０】以上をまとめると、量子化テーブル作成部１４０と逆量子化テーブル作成部２５０は、次のような特徴を有している。

（１）基本量子化テーブルＢＱＴと量子化レベル係数ＱＣｘとを、数式２に従って乗算することによって量子化テーブルＱＴを作成する。

（２）乗算の結果が量子化レベルの最大値（＝１５）以上のものは、最大値に等しく設定する（図６～図８）。

（３）ＤＣ成分用の量子化レベルＱＴ（０，０）は、量子化レベル係数ＱＣｘの値に係わらず基本量子化テーブルＢＱＴにおける値と同一に保つ（図８）。

（４）量子化レベル係数ＱＣｘが０の場合には、すべての量子化レベルを１に設定する（図９）。

【００６１】量子化テーブルＱＴを求める上述の演算は、画像データ圧縮装置１００においてはソフトウエアプログラムによって行なわれ、画像データ伸長装置２００においては専用のハードウエアで構成された逆量子化テーブル作成部２５０によって行なわれる。逆量子化テーブル作成部２５０の具体的な回路構成については更に後述する。

【００６２】なお、量子化レベル係数ＱＣｘは、画像データ圧縮装置１００で画像データを圧縮する際に、キーボード１０３やマウス１０４を用いて画素ブロックＰＢごとに異なる値を指定することができる。

【００６３】Ｃ．ハフマン符号化と圧縮データの構成；
画像データ圧縮装置１００のハフマン符号化部１３０（図１）は、ＤＣ係数符号化部とＡＣ係数符号化部とで構成されている。図１０（Ａ）は、ＤＣ係数符号化部の機能を示すブロック図である。ブロック遅延部１３１と加算器１３２は、図１０（Ｂ）に示すように、各画素ブロックＰＢのＤＣ係数ＤＣｉと１つ前の画素ブロックＰＢのＤＣ係数DC_{i-1}との差分△ＤＣを算出する。

【００６４】カテゴリ化処理部１３３は、図１１に示すカテゴリ化テーブルに従って、ＤＣ係数の差分△ＤＣに対応するカテゴリＳＳＳＳと識別データＩＤとを求める。カテゴリＳＳＳＳは、ＤＣ係数の差分△ＤＣの範囲を示す番号である。識別データＩＤは、カテゴリＳＳＳＳで指定される複数の差分△ＤＣの中の小さい方から何番目の値であるかを示すデータである。

【００６５】カテゴリＳＳＳＳは、さらに１次元ハフマン符号化部１３４（図１０）においてＤＣ係数用のハフマン符号語HF_{DC}に変換される。図１２は、１次元ハフマン符号化部１３４によって使用されるハフマン符号テーブルHT_{DC}の一例を示す説明図である。この実施例では、原画像データｆ（ｘ，ｙ）がＹＵＶ信号（輝度信号Ｙと２つの色差信号Ｕ，Ｖ）で表現されているものとする。Ｕ信号／Ｖ信号共用のＤＣ係数用ハフマン符号テーブルは、０～９のカテゴリＳＳＳＳの符号語を含むだけである。一方、Ｙ信号用のＤＣ係数用ハフマン符号テーブルは、０～９のカテゴリＳＳＳＳの符号語の他に、１５～３１のカテゴリＳＳＳＳの符号語を含んでいる。ＳＳＳＳ＝１５のハフマン符号語は、後述するヌルランデータであることを示している。ヌルランデータは、一様色の画素ブロックＰＢが連続することを示すデータである。また、ＳＳＳＳ＝１６～３１のハフマン符号語は、量子化レベル係数ＱＣｘの値を示す符号である。例えば、ＳＳＳＳ＝１６に対するハフマン符号語「111110000」はＱＣｘ＝０を示しており、ＳＳＳＳ＝３１に対するハフマン符号語「111111111」はＱＣｘ＝１５を示している。なお、図１２のハフマン符号語は、カテゴリＳ

ＳＳＳ＝１～９、および１５～３１のすべてに関して一意復号可能で、かつ、瞬時復号可能である。

【００６６】図１３は、ハフマン符号化部１３０内のＡＣ係数符号化部の機能を示すブロック図である。ＡＣ係数の配列Ｆ（ｕ，ｖ）（ｕ＝ｖ＝０を除く）は、まずジグザグスキャン部１３５によって１次元に並び直される。図１４は、ジグザグスキャンの順路を示す説明図である。

【００６７】判定部１３６は、１次元に並び直されたＡＣ係数の値が０か否かを判定する。ＡＣ係数の値が０であれば、ランレングスカウンタ１３７が、連続する０のＡＣ係数をゼロラン長ＮＮＮＮに変換する。ＡＣ係数が０でなければ、そのＡＣ係数の値がカテゴリ化部１３８によってカテゴリＳＳＳＳと識別データＩＤに変換される。この際、図１１に示すカテゴリ化テーブルが参照される。

【００６８】ゼロラン長ＮＮＮＮとカテゴリＳＳＳＳとは、２次元ハフマン符号化部１３９においてＡＣ係数用のハフマン符号語ＨＦ$_{AC}$に変換される。図１５は、ＡＣ係数用の２次元ハフマン符号テーブルＨＴ$_{AC}$を示す説明図である。また、図１６は、ハフマン符号テーブルＨＴ$_{AC}$の中で、ＮＮＮＮ＝０とＮＮＮＮ＝１の部分（図１５における最上部２行）のハフマン符号語の一例を示している。なお、ＮＮＮＮ／ＳＳＳＳ＝０／０のハフマン符号語「11111」は、１つの画素ブロックに対する符号データの終了を示している。

【００６９】図１７は、ハフマン符号化の一例を示す説明図である。図１７（Ｂ）は、ＤＣ係数の符号化を示している。１つ前の画素ブロックにおけるＤＣ係数の値を０と仮定すると、△ＤＣ＝Ｆ（０，０）＝１２である。図１１のカテゴリ化テーブルによれば△ＤＣ＝１２のカテゴリＳＳＳＳは4であり、識別データＩＤは「1100」である。また、図１２のＤＣ係数用ハフマン符号テーブルによれば、カテゴリＳＳＳＳ＝４のハフマン符号語ＨＦ$_{DC}$は「011」である。なお、ここではＹ信号用のハフマン符号テーブルを使用する。ＤＣ係数に対するハフマン符号（ＨＦ＋ＩＤ）は、図１７（Ｂ）に示すように「0111100」となる。

【００７０】図１７（Ｃ）はＡＣ係数の符号化を示している。まず、ジグザグスキャンによって、ＡＣ係数が一次元の配列に並べられる。この配列は、ゼロラン長ＮＮＮＮと、ゼロでない値のカテゴリＳＳＳＳ（図１１参照）とに変換される。ゼロラン長ＮＮＮＮとカテゴリＳＳＳＳの組み合わせは、図１５および図１６に示すＡＣ係数用ハフマン符号テーブルによってハフマン符号語ＨＦ$_{AC}$に変換され、ゼロでないＡＣ係数の識別データＩＤと組み合わされて、図１７（Ｃ）に示すようにハフマン符号（ＨＦ$_{AC}$＋ＩＤ）が作成される。

【００７１】図１８は、圧縮データの構成を示す説明図である。圧縮データの全体は、図１８（Ａ）に示すように、ヘッダ部と圧縮データ部とダミー部とで構成されている。ヘッダ部は、それぞれ１バイトの４つのデータＤＦＨ，ＤＦＬ，ＤＬＨ，ＤＬＬを有している。最初の２つのデータＤＦＨ，ＤＦＬは、圧縮データ部に含まれるデータの種類を示している。圧縮データ部のデータには、基本量子化テーブルＢＱＴのデータ、フルカラー自然画像圧縮データ、ランレングス画像圧縮データなどの種類がある。ヘッダの後部１６ビットのデータ（ＤＬＨ＋ＤＬＬ）は、圧縮データ部とダミー部の合計のデータ長を示している。圧縮データ部はハフマン符号を含む可変長のデータなので、ダミー部との合計のデータ長が、ワード（＝２バイト）の整数倍の長さになるように調整されている。

【００７２】図１８（Ｂ）は、基本量子化テーブルＢＱＴを表わす圧縮データの構成を示している。この１セットの圧縮データは、Ｙ信号用の基本量子化テーブルＢＱＴを表わすデータと、Ｕ信号／Ｖ信号共用の基本量子化テーブルＢＱＴを表わすデータとを含んでいる。なお、基本量子化テーブルＢＱＴを表わすデータはハフマン符号化しておかなくてもよい。

【００７３】図１８（Ｃ）は、フルカラー自然画像の圧縮データの構成を示している。圧縮データ部には、量子化レベル係数ＱＣｘを表わす符号データ（図１２におけるカテゴリＳＳＳＳ＝１６～３１の符号語）と、各画素ブロックの符号データであるブロックデータと、一様色の複数の画素ブロックを示すヌルランデータとを含んでいる。

【００７４】図１８（Ｄ）に示すように、１ユニットのブロックデータは４組のＹ信号用データと、１組のＵ信号データと、１組のＶ信号用データとで構成されている。図１９は、ＹＵＶの各信号のブロックの関係を示す説明図である。図１９（Ａ）に示すように、この実施例における１画面は、２５６画素×２４０走査線の大きさを有している。Ｙ信号に関しては、間引きをせずに、８×８画素の画素ブロック毎にＤＣＴ変換が行なわれる。一方、Ｕ信号とＶ信号に関しては、図１９（Ｂ）に示すように、横方向と縦方向に１／２に間引き（サブサンプリング）されて、間引き後の８×８画素のブロックに対してＤＣＴ変換が行なわれる。従って、図１９（Ｃ）に示すように、Ｙ信号の４つの画素ブロックＹ１～Ｙ４の領域がＵ信号とＶ信号の１つの画素ブロックの領域に対応している。なお、Ｙ信号を間引きせずにＵ信号とＶ信号を間引きするのは、人間の目が輝度の変化（Ｙ信号の変化）には比較的敏感であるが、色の変化（Ｕ信号とＶ信号の変化）には比較的鈍感だからである。Ｕ信号とＶ信号のみを間引くことによって、画質を過度に劣化させずに圧縮率を高めることができる。なお、図１８（Ｄ）に示す１ユニットのブロックデータは、図１９（Ｃ）に示す各領域のハフマン符号データを順に並べたものである。

【0075】ブロックデータ内の1つの画素ブロックに対する符号データは、図18（F）に示すように、DC係数の1つのハフマン符号データと、AC係数の複数のハフマン符号データとで構成されている。DC係数のハフマン符号データは、前述したように、カテゴリSSSSのハフマン符号語HFDCと識別データIDとで構成される（図18（G））。また、AC係数のハフマン符号データは、ゼロラン長NNNNとカテゴリSSSSとの組み合わせに対するハフマン符号語HFACと、識別データIDとで構成される（図18（H））。

【0076】量子化レベル係数QCxの符号データは、圧縮データ部の先頭と、量子化レベル係数QCxの値を変更したい画素ブロックのブロックデータの直前に挿入されている。2番目の量子化レベル係数QCxが挿入される前の複数の画素ブロックに対しては、先頭の量子化レベル係数QCxが共通に使用される。また、3番目の量子化レベル係数QCx（図示せず）が挿入される前の複数のブロックに対しては、2番目の量子化レベル係数QCxが共通に使用される。

【0077】なお、圧縮データ部の先頭に量子化レベル係数QCxの符号語が含まれていない場合には、QCx＝1であると見なされる。従って、圧縮データ部の先頭に量子化レベル係数QCxが挿入されておらず、途中に量子化レベル係数QCxが1回だけ挿入されている場合にも、量子化レベル係数QCxが2つ指定されていることと等価である。

【0078】量子化レベル係数QCxを表わすハフマン符号は、ブロックデータの間に挿入されているので、新たな量子化レベル係数QCxが復号化された時点の次のブロックデータに対してこの新たな量子化レベル係数QCxを容易に適用することができる。また、図12に示すように、量子化レベル係数QCxの符号データはDC係数用のハフマン符号語で表わされているので、これがブロックデータの間に挿入されていても、この符号データがブロックY1用のDC係数の符号データであるか、量子化レベル係数QCxの符号データであるかを直ちに判断することが可能である。

【0079】圧縮データ部に含まれているヌルランデータは、図18（E）に示すように、ヌルランデータであることを示すDC係数用符号語「NRL」と、ブロック数と、識別データIDとで構成されている。

【0080】図20は、ヌルランデータによって表わされる画像を示す説明図である。図20（A）の原画像の背景BGは一様色で塗られている。図20（A）の楕円の部分は、図20（B）に示すようにすべての画素が同じ画像データ値（f（x，y）＝12）を有する画素ブロックが18個連続しているものと仮定する。図20（C）は、これらの画素ブロックを表わすヌルランデータを示している。このヌルランデータは、16画素ブロック分の第1のヌルランデータNRD1と、2画素ブロック分の第2のヌルランデータNRD2を含んでいる。

【0081】各ヌルランデータNRD1，NRD2の先頭には、ヌルランデータであることを示すDC係数用符号語「NRL」（図12のカテゴリSSSS＝15の符号語「1111011」）を有している。図18（F）に示すように、通常のブロックデータの先頭にはDC係数のハフマン符号が配置されているので、先頭にあるDC係数用符号語を復号化することによって、ヌルランデータと、ブロックデータと、量子化レベル係数QCxの符号データとを一意にかつ瞬時に識別することができる。

【0082】図20（C）に示すように、ブロック数は、AC係数用ハフマン符号語で表わされている。図21は、AC係数用ハフマン符号テーブル（図15）のうちでヌルランデータに使用される部分を示す図である。ヌルランデータに使用される場合には、ゼロラン長NNNNは（［ブロック数］－1）に等しいと設定される。また、AC係数の値は1であるとして、カテゴリSSSS＝1のハフマン符号語が使用される。図20（C）に示す第1のヌルランデータNRD1におけるブロック数のデータ（NNNN／SSSS＝15／1）は一様色の画素ブロックが16個連続していることを示している。また、第2のヌルランデータNRD2におけるブロック数のデータ（NNNN／SSSS＝1／1）は一様色の画素ブロックが2個連続していることを示している。

【0083】各ヌルランデータNRD1，NRD2の後端には、識別データIDが付加されている。この実施例では、ID＝1に固定されている。

【0084】ヌルランデータは、このように、20ビット程度のデータによって連続した複数の画素ブロックが一様色であることを表わすことが可能である。一方、通常のブロックデータによって一様色の1セットのブロック（図19に示すY信号を4画素ブロック、U信号，V信号を各1画素ブロック含む）を表わすには、約300～約400ビット必要である。しかも、複数セットの画素ブロックが一様色であることを示す場合にも、各セットについて約300～約400ビット必要である。従って、ヌルランデータを使用すれば、連続する一様色の多数の画素ブロックを表わす圧縮データのデータ量をかなり低減することが可能である。

【0085】なお、ヌルランデータで表わされる一様色の画素ブロックの輝度信号Yや色差信号U，Vの値は、圧縮データには含まれておらず、ビデオゲームを記述するソフトウェアプログラムの中において指定されている。オペレータは、ビデオゲーム用のソフトウェアプログラムを作成する際に、一様色の画素ブロックの領域（図20（A）では背景BG）の範囲をマウス104で指定するとともに、これらのブロックの輝度や色調をキーボード103やマウス104を用いて指定する。こうすれば、例えばビデオゲーム装置20（図3）を用いてゲームを実行している途中に特定のイベントが発生した

場合に、背景ＢＧの色を時間的に変化させるなどの特殊な視覚的効果を生じさせることができる。なお、ヌルランデータを復号化する具体的な回路構成については更に後述する。

【００８６】Ｄ．逆量子化テーブル作成部の詳細構成：図２２は、図１に示す逆量子化テーブル作成部２５０の内部構成を示すブロック図である。逆量子化テーブル作成部２５０は、基本量子化テーブルＢＱＴを記憶するＲＡＭ２５１と、ＲＡＭ２５１のアドレスを生成するアドレス生成回路２５２と、量子化レベル係数ＱＣｘを保持するラッチ回路２５３と、量子化レベル係数ＱＣｘと基本量子化テーブルＢＱＴとを乗算して量子化テーブルＱＴを生成する乗算ユニット２５４とを備えている。乗算ユニット２５４よって作成された量子化テーブルＱＴは、逆量子化部２２０に供給される。

【００８７】まず、ＣＤ－ＲＯＭに収納されている圧縮画像データＺＺがハフマン復号化部２１０に与えられると、基本量子化テーブルＢＱＴの符号データが最初に復号化されてＲＡＭ２５１に供給される。この基本量子化テーブルＢＱＴは、アドレス生成回路２５２から与えられるライトアドレスに従ってＲＡＭ２５１に記憶される。ＲＡＭ２５１に記憶された基本量子化テーブルＢＱＴは、すべての画素ブロックに対して使用される。

【００８８】アドレス生成回路２５２は、ハフマン復号化部２１０から出力されるＤＣＴ係数データＱＦ（ｕ，ｖ）と同期してリードアドレスを発生し、このリードアドレスに応じてＲＡＭ２５１から基本量子化テーブルＢＱＴが読み出される。一方、ハフマン復号化部２１０で復号化された量子化レベル係数ＱＣｘは、ラッチ回路２５３でラッチされて、次の量子化レベル係数ＱＣｘが与えられるまでラッチ回路２５３に保存される。従って、量子化レベル係数ＱＣｘが新たに供給されるまでは、複数の画素ブロックに対して同じ量子化レベル係数ＱＣｘが共通に使用される。

【００８９】図２３は、逆量子化テーブル作成部２５０（図２２）に含まれているラッチ回路２５３と乗算ユニット２５４の内部構成を示すブロック図である。ラッチ回路２５３は、２つのラッチ４０２，４０４で構成されている。乗算ユニット２５４は、同期クロック作成回路４１２と、ＡＮＤ回路４１４と、Ｕ信号スタート検出回路４１６と、Ｖ信号スタート検出回路４１８と、ＮＡＮＤ回路４２０と、セレクタ４２２と、乗算器４２４と、クリッピング回路４２６と、ゼロ値修正回路４２８とを有している。

【００９０】図２４は、図２３に示す回路の動作を示すタイミングチャートである。ハフマン復号化部２１０（図１）で量子化レベル係数ＱＣｘが復号化されると、量子化レベル係数ＱＣｘのデータがイネーブル信号ＱＥＮとともにラッチ回路２５３に与えられる（図２４（ａ），（ｂ））。第１のラッチ４０２はイネーブル信号ＱＥＮの立ち上がりエッジで量子化レベル係数ＱＣｘをラッチして出力Ｑ１を第２のラッチ４０４に供給する（図２４（ｃ））。

【００９１】図２４（ｄ）に示すように、ＲＡＭ２５１（図２２）からはＹ信号用の基本量子化テーブルＢＱＴが４回読出された後に、Ｕ信号／Ｖ信号共用の基本量子化テーブルＢＱＴが２回読出される。

【００９２】同期クロック作成回路４１２（図２３）には、ＲＡＭ２５１から読出される基本量子化テーブルＢＱＴに同期して、Ｙ信号の期間でＬレベルとなり、Ｕ信号とＶ信号の期間ではＨレベルとなるブロック識別信号ＵＶ／Ｙがアドレス生成回路２５２から与えられる（図２４（ｅ））。また、この際、イネーブル信号ＥＮも同期クロック作成回路４１２に与えられる。同期クロック作成回路４１２は、ブロック識別信号ＵＶ／Ｙを反転して同期クロック信号ＳＣＫ（図２４（ｆ））を生成し、これを第２のラッチ４０４のクロック入力端子に供給する。第２のラッチ４０４は、この同期クロック信号ＳＣＫの立ち上がりエッジで第１のラッチ４０２の出力Ｑ１をラッチして、その出力Ｑ２（図２４（ｇ））をセレクタ４２２のデータ入力端子に供給する。なお、セレクタ４２２の他のデータ入力端子には、固定値「１」が与えられている。

【００９３】Ｕ信号スタート検出回路４１６は、ブロック識別信号ＵＶ／Ｙと１０ＭＨｚの基本クロック信号ＣＬＫとに基づいて、Ｕ信号用の基本量子化テーブルＢＱＴのスタート時刻を示すＵスタート信号ＵＳＴＲＴ（図２４（ｈ））を生成する。このＵスタート信号ＵＳＴＲＴは、ブロック識別信号ＵＶ／Ｙの立ち上がりエッジから１００ナノ秒だけＬレベルになる信号である。

【００９４】ＡＮＤ回路４１４には、６つのブロックＹ１～Ｙ４，Ｕ，Ｖの各期間でレベルが交互に切り替わるブロック切替信号ＳＷＴＣＨ（図２４（ｉ））と、ブロック識別信号ＵＶ／Ｙとが与えられている。Ｖ信号スタート検出回路４１８は、ＡＮＤ回路４１４の出力と１０ＭＨｚの基本クロック信号ＣＬＫとに基づいて、Ｖ信号用の基本量子化テーブルＢＱＴのスタート時刻を示すＶスタート信号ＶＳＴＲＴ（図２４（ｊ））を生成する。このＶスタート信号ＶＳＴＲＴは、ブロック識別信号ＵＶ／ＹがＨレベルの期間において、ブロック切替信号ＳＷＴＣＨの立ち上がりエッジから１００ナノ秒だけＬレベルになる信号である。

【００９５】図２５は、Ｕ信号スタート検出回路４１６とＶ信号スタート検出回路４１８の内部構成を示すブロック図である。これらの回路４１６，４１８は、どちらもＤフリップフロップとＮＡＮＤ回路とで構成されている。Ｕ信号スタート検出回路４１６のＤフリップフロップ４３２のＤ入力端子にはブロック識別信号ＵＶ／Ｙが供給されており、そのクロック入力端子には１０ＭＨｚの基本クロック信号ＣＬＫが入力されている。ＮＡＮＤ

回路４３４の入力端子には、ブロック識別信号ＵＶ／ＹとＤフリップフロップ４３２の反転出力とが与えられている。なお、ブロック識別信号ＵＶ／Ｙは基本クロック信号ＣＬＫに同期している。

【００９６】ブロック識別信号ＵＶ／ＹがＬレベルの間は、Ｄフリップフロップ４３２の反転出力がＨレベルなので、ＮＡＮＤ回路４３４の出力ＵＳＴＲＴはＨレベルに保たれる（図２４（ｈ）参照）。ブロック識別信号ＵＶ／ＹがＬレベルからＨレベルに切り替わった直後は、ＮＡＮＤ回路４３４の出力（Ｕスタート信号ＵＳＴＲＴ）がＬレベルになり、１００ナノ秒後に基本クロック信号ＣＬＫのエッジでＤフリップフロップ４３２が入力をラッチすると、ＮＡＮＤ回路４３４の出力ＵＳＴＲＴは再びＨレベルに戻る。

【００９７】Ｖ信号スタート検出回路４１８の動作も、Ｕ信号スタート検出回路４１６の動作と同じである。ただし、Ｄフリップフロップ４３６のＤ入力端子には、ブロック識別信号ＵＶ／Ｙとブロック切替信号ＳＷＴＣＨの論理積が与えられているので、ブロック識別信号ＵＶ／ＹがＨレベルの期間において、ブロック切替信号ＳＷＴＣＨの立ち上がりエッジから１００ナノ秒だけＶスタート信号ＶＳＴＲＴがＬレベルになる。

【００９８】ＮＡＮＤ回路４２０（図２３）には、Ｕスタート信号ＵＳＴＲＴとＶスタート信号ＶＳＴＲＴとが入力されており、その出力（選択信号ＳＥＬ）はセレクタ４２２のセレクト入力端子に供給されている。選択信号ＳＥＬ（図２４（ｋ））は、Ｕ信号用の期間の始めとＶ信号用の期間の始めに１００ナノ秒だけＨレベルになる。セレクタ４２２は、選択信号ＳＥＬがＬレベルの場合にはラッチ回路２５３から与えられた出力Ｑ２をそのまま出力し、一方、選択信号ＳＥＬがＨレベルの場合には固定値「１」を出力する。セレクタ４２２の出力Ｑ３は、乗算器４２４によって基本量子化テーブルＢＱＴと乗算される。

【００９９】図２４（ｌ）に示すように、Ｕ信号用の期間の始めとＶ信号用の期間の始めには、セレクタ４２２の出力Ｑ３は量子化レベル係数ＱＣｘの値に係わらずに必ず「１」になる。Ｕ信号用とＶ信号用の期間の始めの１００ナノ秒の期間は、ＤＣ係数用の量子化レベルを算出するための期間である。従って、図２３の回路を使用すれば、Ｕ信号とＶ信号に使用するＤＣ係数用の量子化レベルと、指定された量子化レベル係数ＱＣｘとの乗算を実質的に行なわないようにすることができる。換言すれば、図２３に示す回路は、図８（ｃ），（ｄ）に示す演算を実現する回路である。

【０１００】図２３に示すように、乗算器４２４の出力はクリッピング回路４２６とゼロ値修正回路４２８によって修正されて最終的な量子化テーブルＱＴとなる。図２６は、これらの２つの回路４２６，４２８の内部構成を示すブロック図である。

【０１０１】クリッピング回路４２６は、４入力ＯＲ回路４５０と、８個の２入力ＯＲ回路４５２とで構成されている。これらの回路は、量子化レベルを９ビット（最上位ビットは符号ビット）で表現する場合の回路である。４入力ＯＲ回路４５０には、乗算器４２４（図２３）から出力された１４ビットのデータのうちで符号ビットＤ１３を除く上位４ビットＤ９～Ｄ１２が入力されている。８個の２入力ＯＲ回路４５２の一方の入力端子には、４入力ＯＲ回路４５０の出力が与えられており、他方の入力端子には乗算器４２４の出力の下位８ビットＤ１～Ｄ８が与えられている。上位４ビットＤ９～Ｄ１２の少なくとも１つの値が「１」の場合には、８つの２入力ＯＲ回路４５２の出力がすべて「１」になる。従って、乗算器４２４の出力が十進数で２５５以上の場合には、クリッピング回路４２６の出力が２５５に設定される。

【０１０２】ゼロ値修正回路４２８では、クリッピング回路４２６内の７つのビットＤ２～Ｄ８用の７つの２入力ＯＲ回路４５２の出力がそのまま出力される。また、これらの７つの２入力ＯＲ回路４５２の出力と符号ビットＤ１３とが、８つのインバータ４６０にそれぞれ与えられている。８つのインバータ４６０の出力は８入力ＡＮＤ回路４６２に与えられており、このＡＮＤ回路４６２の出力は２入力ＯＲ回路４６４に供給されている。この２入力ＯＲ回路４６４には、最下位ビットＤ１用の２入力ＯＲ回路４５２の出力が与えられている。この結果、乗算器４２４の出力の１３ビットＤ１～Ｄ１３の値がすべて「０」の場合には、ゼロ値修正回路４２８は、最下位ビットの値のみが「１」で他の８ビットの値が「０」の量子化レベルＱＴを出力する。換言すれば、ゼロ値修正回路４２０は、図９（ｃ），（ｄ）に示す演算を実現している。

【０１０３】Ｅ．ヌルランデータの復号化：図２７は、画像データ伸長装置２００におけるハフマン復号化部２１０（図１）の内部構成を示すブロック図である。ハフマン復号化部２１０は、圧縮画像データＺＺをハフマン復号化する復号化部４７０と、制御部４７２と、セレクタ４７４と、ＤＣ係数レジスタ４７６とを備えている。

【０１０４】復号化部４７０は、与えられた圧縮データの種類が基本量子化テーブルＢＱＴ、量子化レベル係数ＱＣｘ、ブロックデータ、ヌルランデータのいずれであるかを判断し、圧縮データの種類を示す状態信号ＳＳを制御部４７２に供給する。制御部４７２は、この状態信号ＳＳに応じて制御信号ＣＴＬ１，ＣＴＬ２，ＣＴＬ３を復号化部４７０と、セレクタ４７４と、ビデオゲーム装置のＭＰＵ４０（図３）とにそれぞれ供給する。復号された基本量子化テーブルＢＱＴと量子化レベル係数ＱＣｘは、復号化部４７０から逆量子化テーブル作成部２５０に供給される。復号後の量子化されたＤＣＴ係数ＱＦ（ｕ，ｖ）は、復号化部４７０からセレクタ４７４

に供給される。

【０１０５】セレクタ４７４のデータ入力端子には、復号化部４７０から与えられたＤＣＴ係数ＱＦ（ｕ，ｖ）の他に、ゼロデータと、ＤＣ係数レジスタ４７６に登録されたＤＣ係数ＱＦ（０，０）とが与えられている。ＤＣ係数レジスタ４７６には、ゲームのソフトウェアプログラムにおいて記述されている一様色の画素ブロックのＤＣ係数ＱＦ（０，０）の値が、ビデオゲーム装置のＭＰＵ４０によって書き込まれる。なお、ＤＣ係数ＱＦ（０，０）は、ＹＵＶ信号に対してそれぞれ異なる値が登録される。

【０１０６】ここで、図２０（Ｃ）に示す２つのヌルランデータＮＲＤ１，ＮＲＤ２を復号化する場合を考える。第１のヌルランデータＮＲＤ１の先頭のデータＮＲＬが復号化部４７０によって検出されると、ヌルランデータであることを知らせる状態信号ＳＳが復号化部４７０から制御部４７２に出力される。制御部４７２は、状態信号ＳＳに応じて直ちに復号化部４７０とＭＰＵ４０に制御信号ＣＴＬ１，ＣＴＬ２をそれぞれ出力して復号化動作を止めるように制御する。また、制御部４７２は、セレクタ４７４に制御信号ＣＴＬ３を供給し、最初のブロックのＤＣ係数として、ＤＣ係数レジスタ４７６に登録されているＤＣ係数ＱＦ（０，０）を選択させる。図２０（Ｂ）に示すように、原画像データｆ（ｘ，ｙ）の値が１２の場合には、ＱＦ（０，０）＝１２がＤＣ係数レジスタ４７６に登録されている。制御部４７２は、さらに、６３個のＡＣ係数として、すべてゼロデータを選択するようにセレクタ４７４を制御する。図２８は、こうして作成されたＤＣＴ係数ＱＦ（ｕ，ｖ）を示している。

【０１０７】第１のヌルランデータＮＲＤ１は、一様色のブロックが１６個連続していることを示しているので、１６個の画素ブロックのそれぞれについて、図２８に示すＤＣＴ係数ＱＦ（ｕ，ｖ）が作成される。第２のヌルランデータＮＲＤ２についても同様に、２つのブロックのそれぞれについて、図２８に示すＤＣＴ係数ＱＦ（ｕ，ｖ）が作成される。

【０１０８】ヌルランデータの処理が終了すると、制御部４７２が復号化部４７０とＭＰＵ４０に対して制御信号ＣＴＬ１，ＣＴＬ２を出力し、復号化動作を再開するよう制御する。ヌルランデータによって一様色であることが指定されている画素ブロックの輝度信号Ｙや色差信号Ｕ，Ｖの値は、ＭＰＵ４０からＤＣ係数レジスタ４７６に書き込むＤＣ係数の値を変更することによって容易に変更することができる。言い換えれば、ヌルランデータを利用すれば、一様色の画像領域の色を圧縮画像データ以外のデータに応じて所望の色に変更することができる。この実施例では、一様色のブロックの輝度信号Ｙや色差信号Ｕ，Ｖの値は、ビデオゲームを記述するソフトウェアプログラムの中で指定されている。

【０１０９】図２９は、ハフマン復号化部の他の構成を示すブロック図である。このハフマン復号化部２１０ａでは、復号化部４７０から出力されたＤＣＴ係数ＱＦ（ｕ，ｖ）がセレクタ４７４をバイパスして逆量子化部２２０に直接与えられている。セレクタ４７４は、ＤＣ係数レジスタ４７６から与えられるＤＣ係数ＱＦ（０，０）とゼロデータの一方を選択し、逆量子化部２２０をバイパスしてＩＤＣＴ部２３０に直接供給している。制御部４７８は、図２７と同様の３つの制御信号ＣＴＬ１～ＣＴＬ３の他に、第４の制御信号ＣＴＬ４をＩＤＣＴ部２３０に出力している。

【０１１０】制御部４７８は、圧縮データの種類を示す状態信号ＳＳに応じて復号化部４７０と、ＭＰＵ４０と、ＩＤＣＴ部２３０とに、制御信号ＣＴＲＬ１，ＣＴＬ２，ＣＴＬ４をそれぞれ出力する。復号化部４７０で通常のブロックデータが復号されると、復号化されたＤＣＴ係数ＱＦ（ｕ，ｖ）が逆量子化部２２０に供給される。

【０１１１】図２０（Ｃ）に示す第１のヌルランデータＮＤＲ１の先頭のデータＮＲＬが復号化部４７０によって検出されると、ヌルランデータであることを知らせる状態信号ＳＳが復号化部４７０から制御部４７８に出力される。制御部４７８は、状態信号ＳＳに応じて直ちに復号化部４７０とＭＰＵ４０に制御信号ＣＴＬ１，ＣＴＬ２をそれぞれ出力して復号化動作を止めるように制御する。また制御部４７８は、セレクタ４７４に与える制御信号ＣＴＬ３のレベルを切換えて、ＤＣ係数レジスタ４７６に登録されているＤＣ係数ＱＦ（０，０）を選択させる。制御部４７８は、さらに、６３個のＡＣ係数として、すべてゼロデータを選択するようにセレクタ４７４を制御する。制御部４７８は、同時にＩＤＣＴ部２３０に対して制御信号ＣＴＬ４を出力し、セレクタ４７４の出力を選択して逆変換するように制御する。

【０１１２】ヌルランデータの処理が終了すると、制御部４７８から復号化部４７０とＭＰＵ４０に制御信号ＣＴＬ１，ＣＴＬ２が出力され、復号動作を再開するよう制御する。

【０１１３】このように、図２９に示す回路では、ヌルランデータの処理の際には、セレクタ４７４から出力されるＤＣＴ係数ＱＦ（ｕ，ｖ）が逆量子化部２２０をバイパスしてＩＤＣＴ部２３０に直接供給されるので、逆量子化による演算誤差が生じないという利点がある。例えば、特定の色の部分を検出し透明色にするクロマキー処理をビデオエンコーダユニット５０（図３）によって行う時に、量子化による演算誤差が最小に押さえられるので、所望の色の画素ブロックを確実に透明色にすることが可能である。

【０１１４】上記の実施例においては、ヌルランデータによってＤＣ係数のみを任意に設定できるようにしたが、ＡＣ係数の所定の部分（例えばＱＦ（１，０）とＱ

Ｆ（０，１））に対して所望の値を設定できるようにすることも可能である。この場合には、ヌルランデータは同一の画像パターンを有する一連の画素ブロックの個数を表わす。

【０１１５】Ｆ．変形例：なお、この発明は上記実施例に限られるものではなく、その要旨を逸脱しない範囲において種々の態様において実施することが可能であり、例えば次のような変形も可能である。

【０１１６】（１）上記実施例では直交変換として２次元ＤＣＴ変換を取り上げたが、本発明には任意の直交変換（例えばＫ－Ｌ変換やアダマール変換）が利用可能である。また、エントロピー符号化としては、ハフマン符号化以外の任意の符号化（例えば算術符号化やＭＥＬ符号化）を利用することができる。

【０１１７】（２）画像データ圧縮装置１００はハードウェアで実現してもよく、また、画像データ伸長装置２００をソフトウェアで実現してもよい。図３０は、ソフトウェアによって図１８に示す圧縮データを伸長する処理の手順を示すフローチャートである。ステップＳ１では、ヘッダ部の値から圧縮データの内容を判断する。圧縮データが基本量子化テーブルＢＱＴを表わしている場合には、ステップＳ２において基本量子化テーブルＢＱＴをメモリに記憶し、ステップＳ１に戻る。

【０１１８】圧縮データが画像を表わしている場合には、ステップＳ３において圧縮データ部内に含まれている各データユニットの先頭データの種類が判断される。ここで、データユニットとは、図１８（Ｃ）に示す量子化レベル係数ＱＣｘの符号データ、ブロックデータ、ヌルランデータのそれぞれを意味している。図１８（Ｃ），（Ｄ），（Ｅ），（Ｆ）に示すように、データユニットの先頭データとしては、量子化レベル係数ＱＣｘを表わすハフマン符号語と、ブロックデータのＤＣ係数△ＤＣのハフマン符号語と、ヌルランを表わすハフマン符号語ＮＲＬの３種類がある。

【０１１９】先頭データが量子化レベル係数ＱＣｘのハフマン符号語である場合には、ステップＳ４において、この量子化レベル係数ＱＣｘと基本量子化テーブルＢＱＴを乗ずることによって量子化テーブルＱＴを作成する。なお、この乗算の際に、前述した特徴、すなわち、（１）乗算結果が最大値以上の量子化レベルを最大値に設定すること、（２）ＤＣ係数は量子化しないこと、（３）量子化レベル係数ＱＣｘの値が０の時にはすべての量子化レベルを１に設定すること、が実現される。ステップＳ４において量子化テーブルＱＴが作成されると、ステップＳ３に戻る。

【０１２０】ステップＳ３において先頭データがＤＣ係数△ＤＣのハフマン符号語であると判断された場合には、ステップＳ５において１画素ブロック分のデータが復号化されてＤＣＴ係数ＱＦ（ｕ，ｖ）が得られる。ステップＳ６では逆量子化が行なわれ、ステップＳ７では、２次元ＤＣＴ逆変換が行なわれる。１セットのブロックデータ（図１８（Ｄ））に含まれるすべての画素ブロックについてステップＳ５～Ｓ７の処理が繰り返されると、ステップＳ８からステップＳ３に戻る。

【０１２１】ステップＳ３において、先頭データがヌルランデータであることを示すハフマン符号語ＮＲＬであると判断された場合には、ステップＳ９において、１画素ブロックのＤＣ成分が予め指定された値に設定されるとともに、６３個のＡＣ成分がすべて０に設定される。ステップＳ１０では、こうして作成されたＤＣＴ係数に対して２次元ＤＣＴ逆変換が行なわれる。ヌルランデータで指定されたブロック数だけステップＳ９，Ｓ１０の処理が繰り返されると、ステップＳ１１からステップＳ３に戻る。こうして、ステップＳ３～Ｓ１１の処理を圧縮データ部のすべてに亘って実行することによって画像データｆｆ（ｘ，ｙ）が復元される。

【０１２２】（３）上記実施例では、本発明をビデオゲーム装置に適用した例を示したが、本発明はあらゆる種類の画像処理装置に適用することが可能である。

【０１２３】（４）上記実施例では、量子化レベル係数ＱＣｘや量子化テーブルＱＴ内の各量子化レベルを整数としたが、これらは小数を含む数でもよい。

【０１２４】

【発明の効果】以上説明したように、請求項１，１２および２３に記載した発明によれば、第１と第２の係数を与えるだけで量子化レベルの異なる第１と第２の量子化テーブルを作成できるので、２つの量子化テーブルを圧縮画像データに含める場合に比べて圧縮画像データのデータ量を低減することができるという効果がある。

【０１２５】請求項２，１３および２４およびに記載した発明によれば、第１と第２の係数を第１と第２の画素ブロックにそれぞれ容易に対応づけられるという効果がある。

【０１２６】請求項３，１４および２５に記載した発明によれば、第１と第２の係数を一意にかつ瞬時に復号することができるという効果がある。

【０１２７】請求項４および１５に記載した発明によれば、第２の係数が現われるまでの複数の画素ブロックに対して第１の係数が適用されるので、これらの複数の画素ブロックのそれぞれの符号データの前に第１の係数を含めておく必要がなく、従って、圧縮画像データのデータ量を低減することができるという効果がある。

【０１２８】請求項５および１６に記載した発明によれば、量子化レベルのビット数を一定値以下に保つことができるという効果がある。

【０１２９】請求項６および１７に記載した発明によれば、所定の位置の変換係数を逆量子化するさいに発生する誤差を低減することができるという効果がある。

【０１３０】請求項７および１８に記載した発明によれば、変換係数の直流成分に対する量子化レベルを変えな

いようにすれば、直流成分の逆量子化にともなう誤差を低減することができるという効果がある。

【０１３１】請求項８および１９に記載した発明によれば、互いに同一の画像パターンを有する連続した複数の画素ブロックを比較的少ないデータで表わすことができるという効果がある。

【０１３２】請求項９および２０に記載した発明によれば、連続した複数の画素ブロックを同一の色で塗ることができるという効果がある。

【０１３３】請求項１０および２１に記載した発明によれば、逆量子化による誤差の発生を防止することができるという効果がある。

【０１３４】請求項１１に記載した発明によれば、互いに同一のパターンの色を有する連続した複数の画素ブロックを比較的少ないデータで表わすことができるという効果がある。

【０１３５】請求項２６に記載した発明によれば、互いに同一の画像パターンを有する連続した複数の画素ブロックを比較的少ないデータで表わすことができるという効果がある。

【０１３６】請求項２７に記載した発明によれば、第１の画素ブロックを含む少なくとも１つの画素ブロックに対して新たな量子化テーブルを使用する場合に第１の係数コードを圧縮画像データに含めておけばよいので、圧縮画像データのデータ量を低減することができるという効果がある。

【０１３７】請求項２８に記載した発明によれば、第１と第２の係数を与えるだけで量子化レベルの異なる第１と第２の量子化テーブルを作成できるので、２つの量子化テーブルを圧縮画像データに含める場合に比べて圧縮画像データのデータ量を低減することができるという効果がある。

【０１３８】また、請求項２９に記載した発明によれば、第１と第２の係数を第１と第２の画素ブロックにそれぞれ容易に対応づけられるという効果がある。

【図面の簡単な説明】

【図１】この発明の一実施例を適用した画像データの圧縮装置と伸長装置の機能を示すブロック図。

【図２】画像データ圧縮装置１００の具体的な構成を示すブロック図。

【図３】画像データ伸長装置２００の具体的な構成を示すブロック図。

【図４】原画像を示す平面図。

【図５】ＤＣＴ係数Ｆ（ｕ，ｖ）の配列を示す説明図。

【図６】圧縮／伸長の基本動作を示す説明図。

【図７】量子化レベル係数ＱＣｘが４の場合の圧縮／伸長動作を示す説明図。

【図８】量子化においてＤＣ成分を変更しない場合の動作を示す説明図。

【図９】量子化レベル係数ＱＣｘが０の場合の圧縮／伸長動作を示す説明図。

【図１０】ＤＣ係数符号化部の機能を示すブロック図。

【図１１】ハフマン符号化におけるカテゴリ化テーブルを示す図。

【図１２】ＤＣ係数用のハフマン符号テーブルＨＴ$_{DC}$の一例を示す説明図。

【図１３】ＡＣ係数符号化部の機能を示すブロック図。

【図１４】ＡＣ係数のジグザグスキャンの順路を示す説明図。

【図１５】ＡＣ係数用の２次元ハフマン符号テーブルを示す説明図。

【図１６】ハフマン符号テーブルの内容を示す図。

【図１７】ハフマン符号化の一例を示す説明図。

【図１８】圧縮データの構成を示す説明図。

【図１９】ＹＵＶの各信号のブロックの関係を示す説明図。

【図２０】ヌルランデータによって表わされる画像を示す説明図。

【図２１】ＡＣ係数用のハフマン符号テーブルの他の部分を示す図。

【図２２】逆量子化テーブル作成部２５０の内部構成を示すブロック図。

【図２３】ラッチ回路２５３と乗算ユニット２５４の内部構成を示すブロック図。

【図２４】図２３に示す回路の動作を示すタイミングチャート。

【図２５】Ｕ信号スタート検出回路４１６とＶ信号スタート検出回路４１８の内部構成を示すブロック図。

【図２６】クリッピング回路４２６とゼロ値修正回路４２８の内部構成を示すブロック図。

【図２７】ハフマン復号化部２１０の内部構成を示すブロック図。

【図２８】ヌルランデータを復号化して得られたＤＣＴ係数を示す図。

【図２９】ハフマン復号化部の他の構成を示すブロック図。

【図３０】ソフトウェアによって圧縮データを復号する処理の手順を示すフローチャート。

【図３１】従来の画像データ圧縮装置と伸長装置を示すブロック図。

【符号の説明】

２０…ビデオゲーム装置

２１…ＲＯＭ

２４，２６…ゲームパッド

２８…カラーテレビ

３０…ビデオ信号ケーブル

３２…ＣＤ－ＲＯＭドライブ

３４…スピーカ

３６…ＳＣＳＩバス

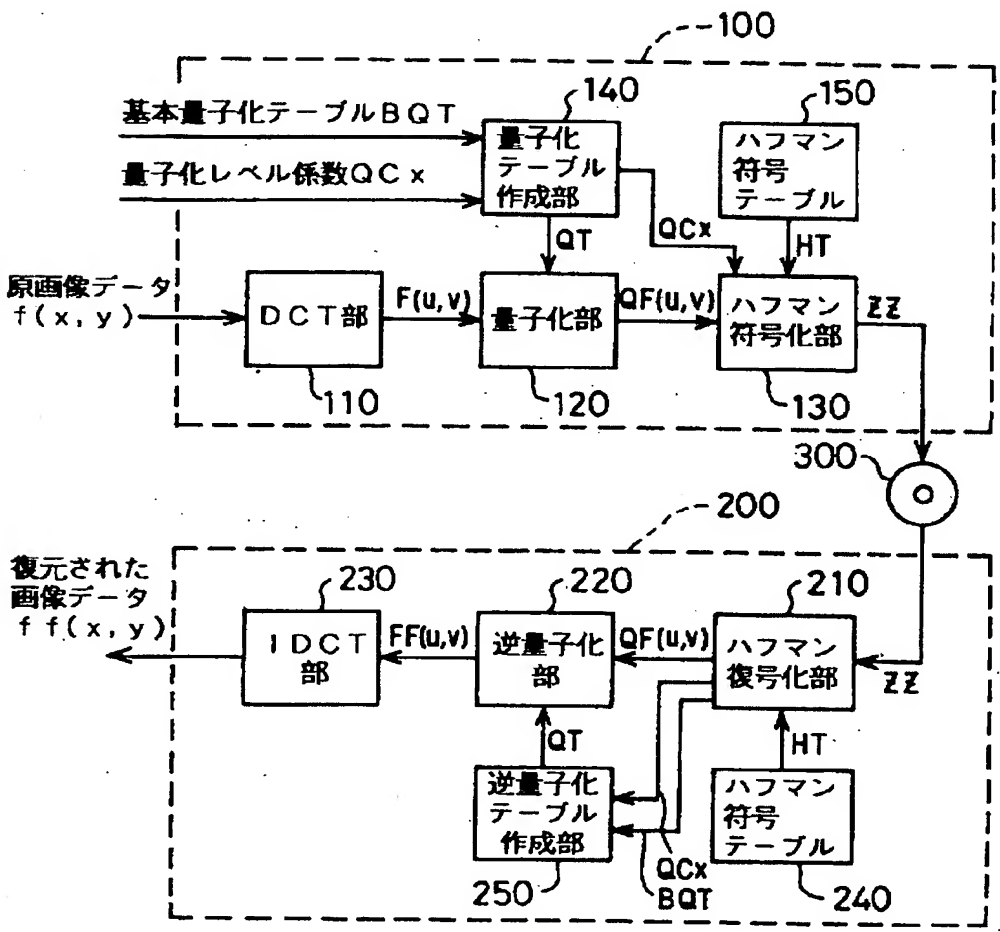
３８…スピーカ

４０…ＭＰＵ
４０ａ…演算部
４０ｂ…コントローラ
４１…メインメモリ
４２…ＲＯＭ
４３…Ｍ－ＢＵＳ
４５…画像信号コントロールユニット
４５ａ…ＭＰＵＩ／Ｆ
４５ｂ…ＳＣＳＩコントローラ
４５ｃ…ＡＦＦＩＮコンバータ
４５ｄ…グラフィックコントローラ
４５ｅ…サウンドコントローラ
４９…ＶＤＰユニット
５０…ビデオエンコーダユニット
５０ａ…ルックアップテーブル
５０ｂ…優先順位設定部
５０ｃ…ミキサー
５０ｃ…画像データ合成部
５０ｄ…スーパーインポーズ部
５０ｅ…ＤＡＣ
５２…音声出力ユニット
５２ａ…ＡＤＰＣＭ部
５５…ＲＡＭ
５９…ＲＡＭ
６０…ＮＴＳＣコンバータ
１００…画像データ圧縮装置
１０１…ＣＰＵ
１０２…メインメモリ
１０３…キーボード
１０４…マウス
１０５…磁気ディスク装置
１０６…光磁気ディスク装置
１１０…ＤＣＴ部
１２０…量子化部
１３０…ハフマン符号化部
１３１…ブロック遅延部
１３２…加算器
１３３…カテゴリ化処理部
１３４…１次元ハフマン符号化部
１３５…ジグザグスキャン部
１３６…判定部
１３７…ランレングスカウンタ
１３８…カテゴリ化部
１４０…量子化テーブル作成部
１５０…ハフマン符号テーブルメモリ
２００…画像データ伸長装置
２１０…ハフマン復号化部
２２０…逆量子化部
２３０…ＩＤＣＴ部
２４０…ハフマン符号テーブルメモリ

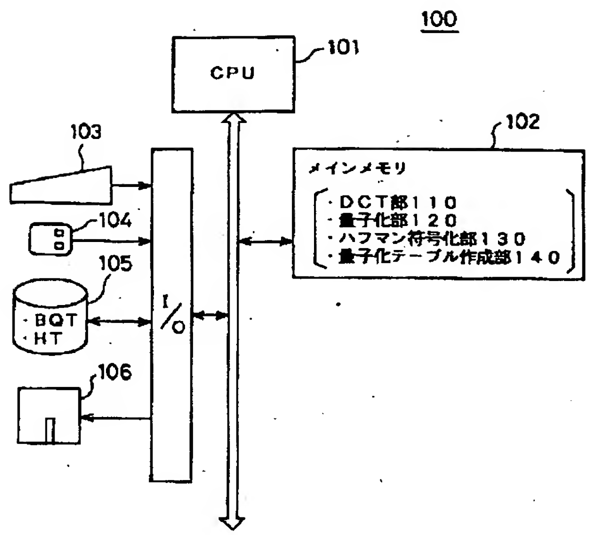
２５０…逆量子化テーブル作成部
２５１…ＲＡＭ
２５２…アドレス生成回路
２５３…ラッチ回路
２５４…乗算ユニット
４０２，４０４…ラッチ
４１２…同期クロック作成回路
４１４…ＡＮＤ回路
４１６…Ｕ信号スタート検出回路
４１８…Ｖ信号スタート検出回路
４２０…ＮＡＮＤ回路
４２２…セレクタ
４２４…乗算器
４２６…クリッピング回路
４２８…ゼロ値修正回路
４３２，４３６…Ｄフリップフロップ
４３４，４３８…ＮＡＮＤ回路
４５０…４入力ＯＲ回路
４５２…２入力ＯＲ回路
４６０…インバータ
４６２…ＡＮＤ回路
４６４…ＯＲ回路
４７０…復号化部
４７２…制御部
４７４…セレクタ
４７６…ＤＣ係数レジスタ
４７８…制御部
５４０…画像データ圧縮装置
５４２…直交変換部
５４４…量子化部
５４６…エントロピー符号化部
５５０…画像データ伸長装置
５５０…伸長装置
５５２…逆直交変換部
５５４…逆量子化部
５５６…エントロピー復号化部
５６２…量子化テーブル
５６４…符号テーブル
ＢＧ…背景
ＢＱＴ…基本量子化テーブル
ＣＬＫ…基本クロック信号
Ｄ１～Ｄ１３…乗算器４２４の出力
Ｄ１３…符号ビット
ＥＮ…イネーブル信号
ｆ（ｘ，ｙ）…原画像データ
ｆｆ（ｘ，ｙ）…復号された画像データ
Ｆ（ｕ，ｖ）…元のＤＣＴ係数
ＦＦ（ｕ，ｖ）…復号されたＤＣＴ係数
HF_{AC}…ＡＣ係数用ハフマン符号語
HF_{DC}…ＤＣ係数用ハフマン符号語

ＨＴAC…ＡＣ係数用ハフマン符号テーブル
ＨＴDC…ＤＣ係数用ハフマン符号テーブル
ＨＴ…ハフマン符号テーブル
ＩＤ…識別データ
ＮＮＮＮ…ゼロラン長
ＮＲＬ…ヌルランデータ
ＰＢ…画素ブロック
ＰＸ…画素
ＱＣｘ…量子化レベル係数
ＱＥＮ…イネーブル信号
ＱＦ…量子化されたＤＣＴ係数
＊ＱＴ…量子化テーブル
ＳＣＫ…同期クロック信号
ＳＥＬ…選択信号
ＳＳ…状態信号
ＳＳＳＳ…カテゴリ
ＳＷＴＣＨ…ブロック切替信号
Ｕ，Ｖ…色差信号
ＵＳＴＲＴ…Ｕスタート信号
ＶＳＴＲＴ…Ｖスタート信号
Ｙ…輝度信号
＊ ＺＺ…圧縮画像データ

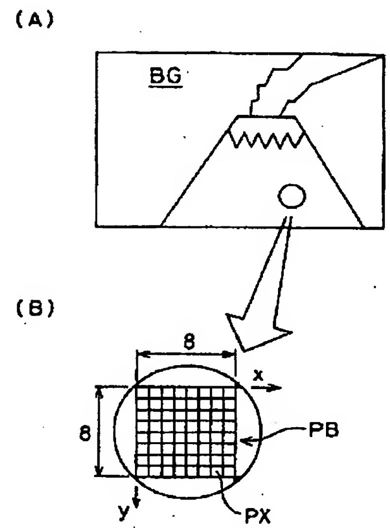
【図１】



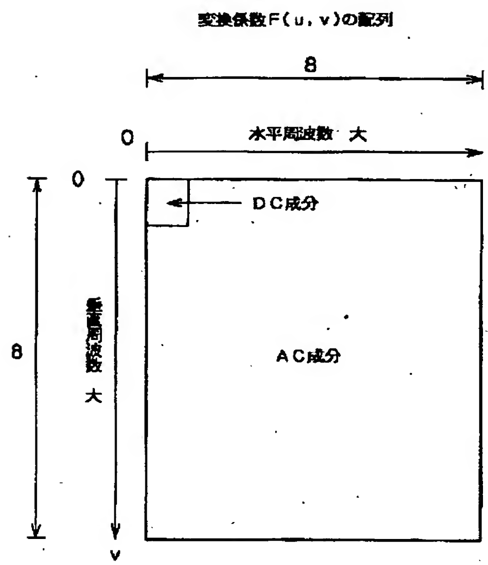
【図2】



【図4】



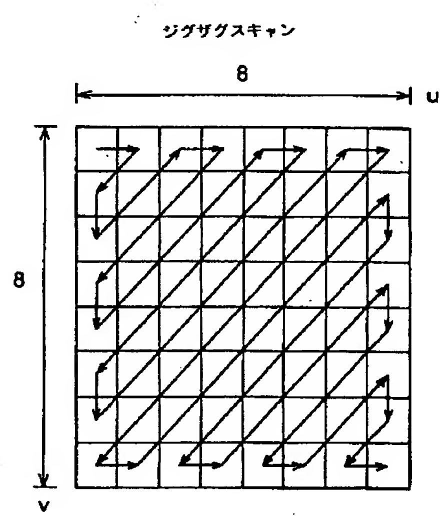
【図5】



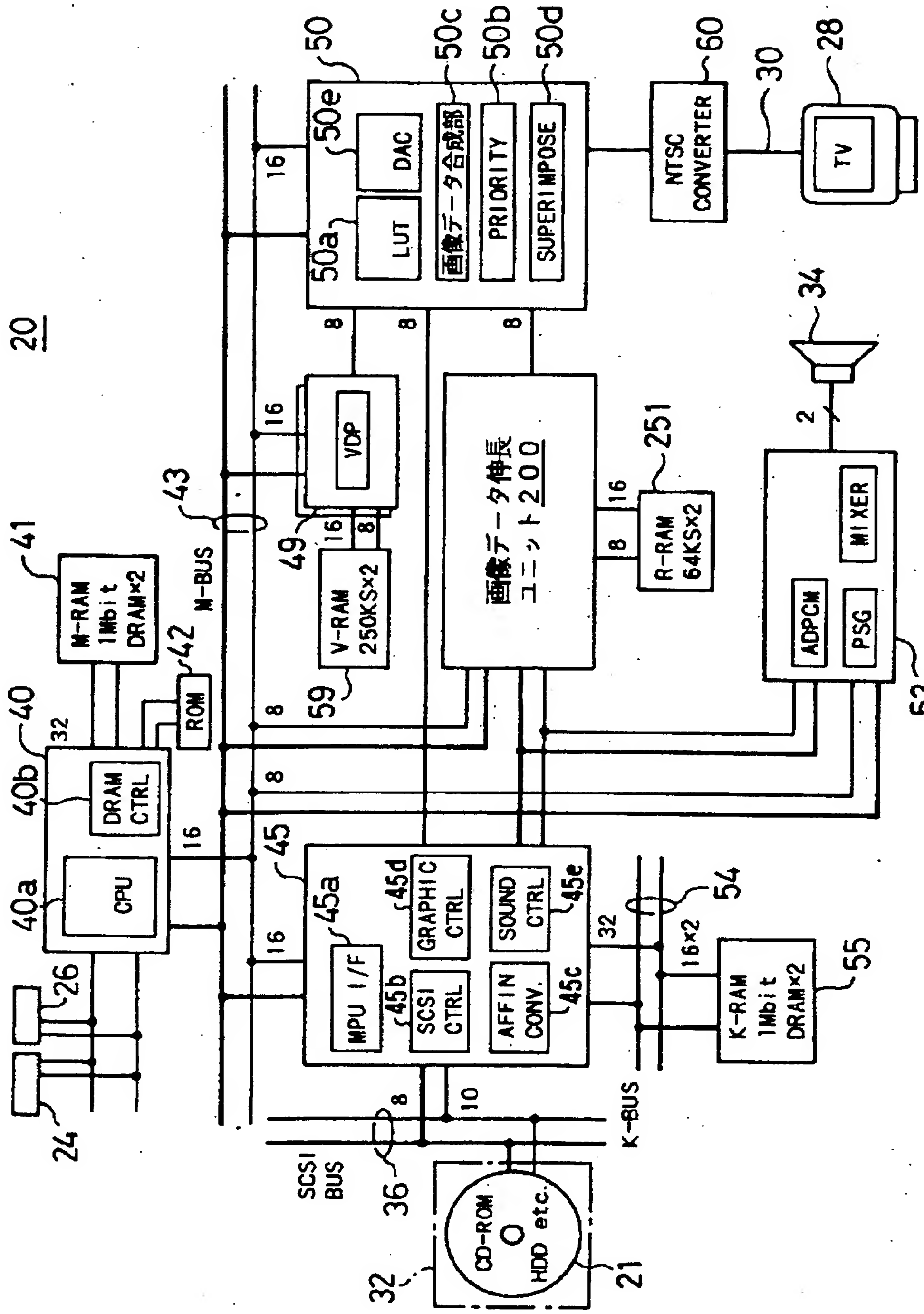
【図11】

カテゴリ SSSS	ΔDC／AC 係数値	識別データ ビット数
0	0	0
1	−1,　1	1
2	−3..−2,　2..3	2
3	−7..−4,　4..7	3
4	−15..−8,　8..15	4
5	−31..−16,　16..31	5
6	−63..−32,　32..63	6
7	−127..−64,　64..127	7
8	−255..−128,　128..255	8
9	−511..−256,　256..511	9

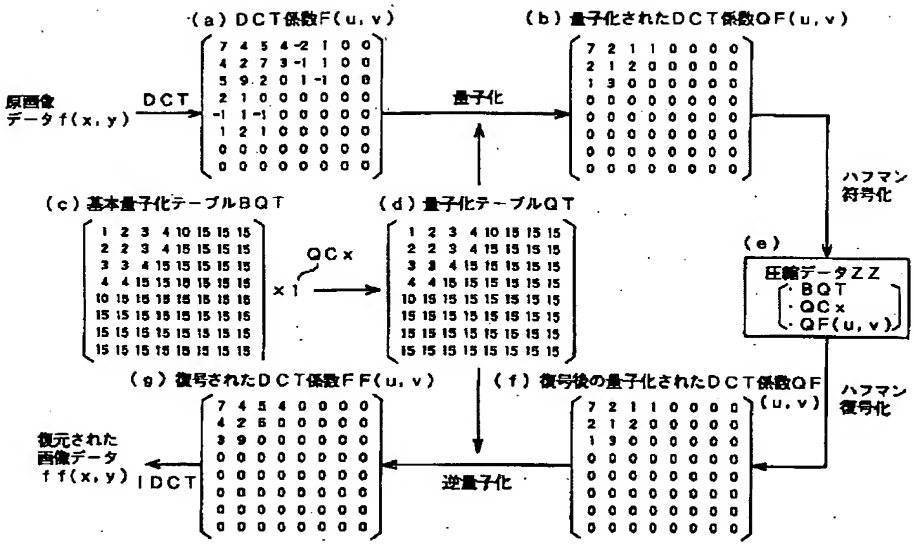
【図14】



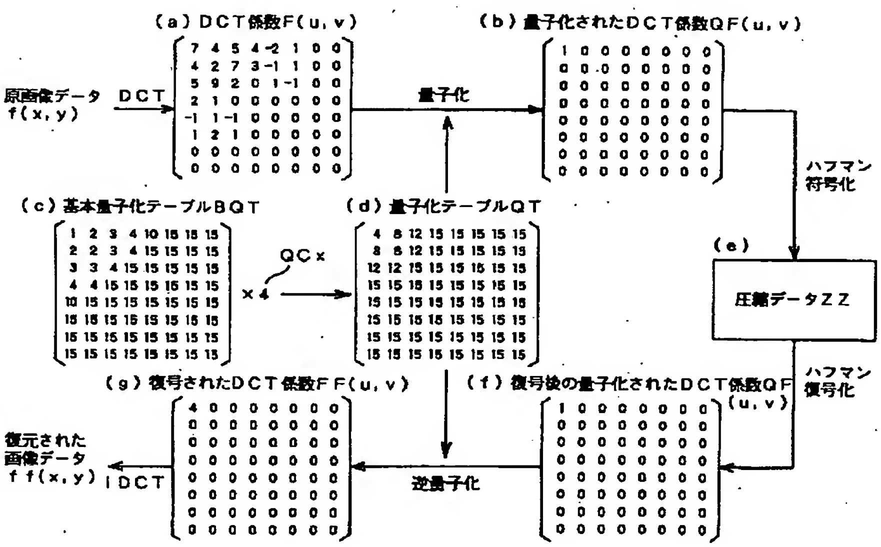
【図3】


20
CPU
DRAM CTRL
M-RAM 1Mbit DRAM×2
ROM
M-BUS
V-RAM 250KS×2
VDP
LUT
DAC
画像データ合成部
PRIORITY
SUPERIMPOSE
NTSC CONVERTER
TV
画像データ伸長ユニット200
R-RAM 64KS×2
ADPCM
PSG
MIXER
MPU I/F
SCSI CTRL
AFFIN CONV.
GRAPHIC CTRL
SOUND CTRL
K-RAM 1Mbit DRAM×2
K-BUS
SCSI BUS
CD-ROM HDD etc.

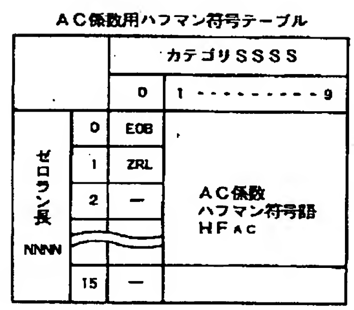
【図6】


(a) DCT係数F(u, v)
(b) 量子化されたDCT係数QF(u, v)
原画像
データf(x, y)
DCT
量子化
ハフマン
符号化
(c) 基本量子化テーブルBQT
(d) 量子化テーブルQT
QCx
×1
(e)
圧縮データZZ
・BQT
・QCx
・QF(u, v)
(g) 復号されたDCT係数FF(u, v)
(f) 復号後の量子化されたDCT係数QF
(u, v)
ハフマン
復号化
復元された
画像データ
ff(x, y)
IDCT
逆量子化

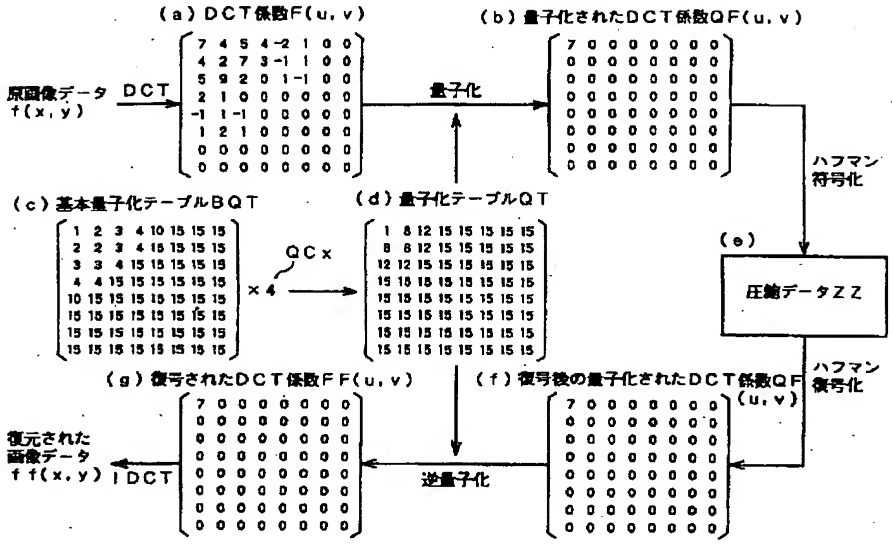
【図7】


(a) DCT係数F(u, v)
(b) 量子化されたDCT係数QF(u, v)
原画像データ
f(x, y)
DCT
量子化
ハフマン
符号化
(c) 基本量子化テーブルBQT
(d) 量子化テーブルQT
QCx
×4
(e)
圧縮データZZ
(g) 復号されたDCT係数FF(u, v)
(f) 復号後の量子化されたDCT係数QF
(u, v)
ハフマン
復号化
復元された
画像データ
ff(x, y)
IDCT
逆量子化

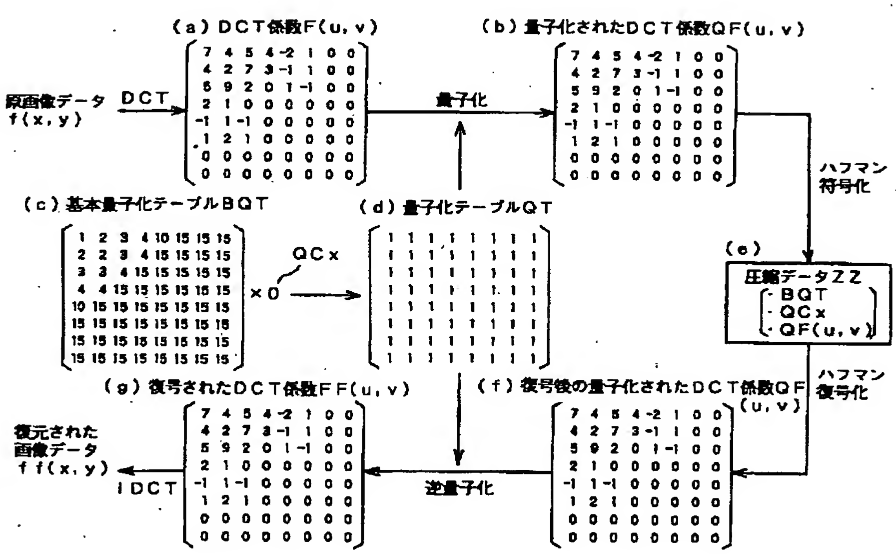
【図15】


AC係数用ハフマン符号テーブル
カテゴリSSSS
0
1 - - - - - - - - - 9
ゼロラン長
NNNN
0
EOB
1
ZRL
2
15
AC係数
ハフマン符号語
HFAC

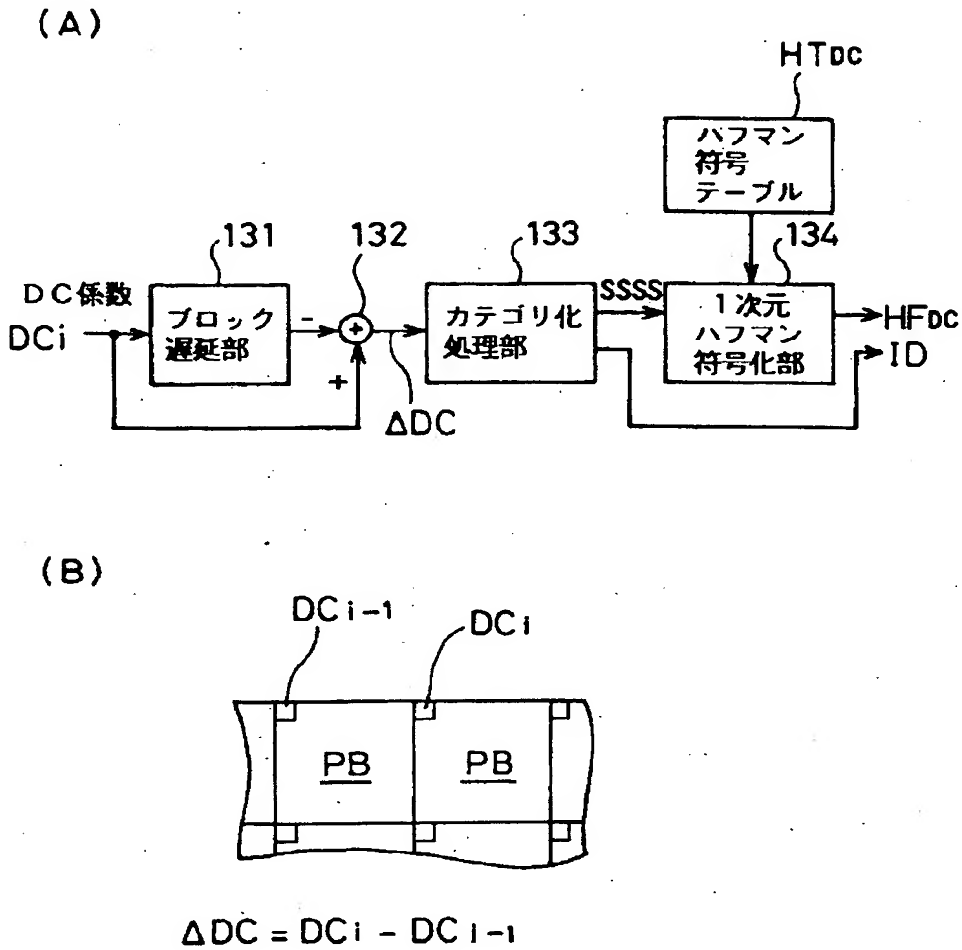
【図8】


(a) DCT係数F(u, v)
(b) 量子化されたDCT係数QF(u, v)
原画像データ
f(x, y)
DCT
量子化
ハフマン符号化
(c) 基本量子化テーブルBQT
(d) 量子化テーブルQT
QCx
×4
(e)
圧縮データZZ
ハフマン復号化
(g) 復号されたDCT係数FF(u, v)
(f) 復号後の量子化されたDCT係数QF(u, v)
復元された画像データ
ff(x, y)
IDCT
逆量子化

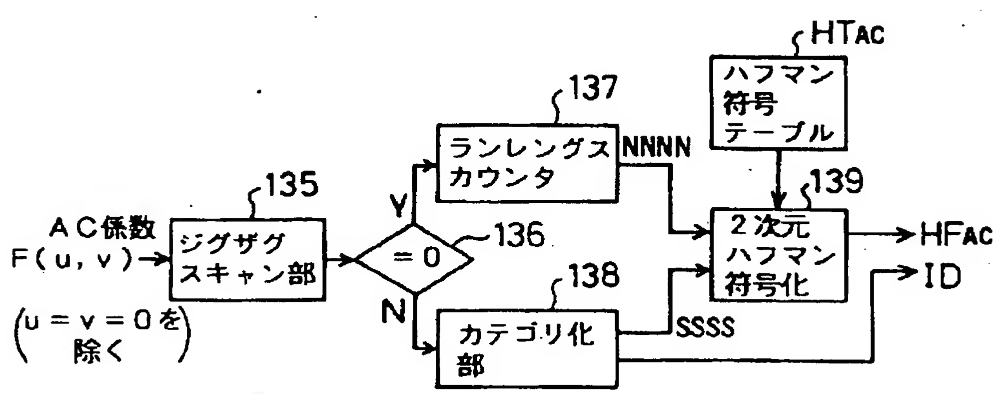
【図9】


(a) DCT係数F(u, v)
(b) 量子化されたDCT係数QF(u, v)
原画像データ
f(x, y)
DCT
量子化
ハフマン符号化
(c) 基本量子化テーブルBQT
(d) 量子化テーブルQT
QCx
×0
(e)
圧縮データZZ
・BQT
・QCx
・QF(u, v)
ハフマン復号化
(g) 復号されたDCT係数FF(u, v)
(f) 復号後の量子化されたDCT係数QF(u, v)
復元された画像データ
ff(x, y)
IDCT
逆量子化

【図10】


(A)
HTDC
ハフマン
符号
テーブル
131
132
133
134
DC係数
DCi
ブロック
遅延部
カテゴリ化
処理部
SSSS
1次元
ハフマン
符号化部
HFDC
ID
ΔDC
(B)
DCi-1
DCi
PB
PB
ΔDC = DCi - DCi-1

【図13】


HTAC
ハフマン
符号
テーブル
137
ランレングス
カウンタ
NNNN
139
135
AC係数
F(u, v)
(u = v = 0を
除く)
ジグザグ
スキャン部
Y
= 0
136
N
138
カテゴリ化
部
SSSS
2次元
ハフマン
符号化
HFAC
ID

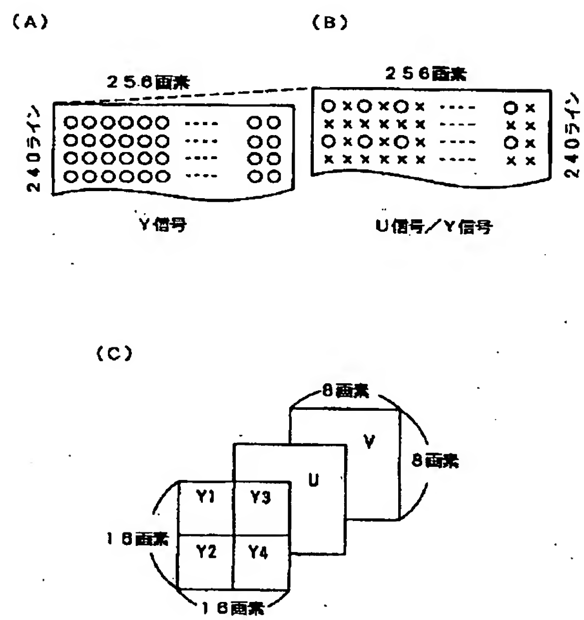
【図12】

カテゴリ SSSS	ΔDC 係数 ハフマン符号語 HF_{DC}	
	Y信号用	U信号、V信号用
0	000	00
1	1110	01
2	001	10
3	010	110
4	011	1110
5	100	11110
6	101	111110
7	110	1111110
8	111100	11111110
9	1111010	11111111
10		
11		
12		
13		
14		
15(NRL)	1111011	
16(QC0)	111110000	
17(QC1)	111110001	
18(QC2)	111110010	
19(QC3)	111110011	
20(QC4)	111110100	
21(QC5)	111110101	
22(QC6)	111110110	
23(QC7)	111110111	
24(QC8)	111111000	
25(QC9)	111111001	
26(QC10)	111111010	
27(QC11)	111111011	
28(QC12)	111111100	
29(QC13)	111111101	
30(QC14)	111111110	
31(QC15)	111111111	

【図16】

ゼロラン長 NNNN / カテゴリ SSSS	AC係数ハフマン符号語HF_{AC}	
	Y信号用	U信号，V信号用
0/0 (EOB)	11111	11111
0/1	00	00
0/2	01	01
0/3	100	1010
0/4	1010	11000
0/5	11000	1110010
0/6	110110	111100010000
0/7	111011100	111100010001
0/8	111100010000	111100010010
0/9	11101111000	11101111000
1/0 (ZRL)	111101111111	111101111111
1/1	1011	100
1/2	11001	11001
1/3	1110100	1110011
1/4	111100010001	111100010011
1/5	111100010010	111100010100
1/6	111100010011	111100010101
1/7	111100010100	111100010110
1/8	111100010101	111100010111
1/9	11101111001	11101111001

【図19】



【図17】

(A) DCT係数F(u, v)

DCi

12	0	4	0	0	0	1	0
-4	3	0	-2	0	0	0	0
0	5	3	0	1	0	0	0
-4	0	0	0	0	0	0	0
0	2	0	0	0	0	0	0
0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

(B) DC係数符号化($DC_{i-1}=0$)

$\Delta DC=12 \rightarrow SSSS=4 \rightarrow HF_{DC}+ID=\underbrace{0111}_{HF_{DC}}\underbrace{100}_{ID}$

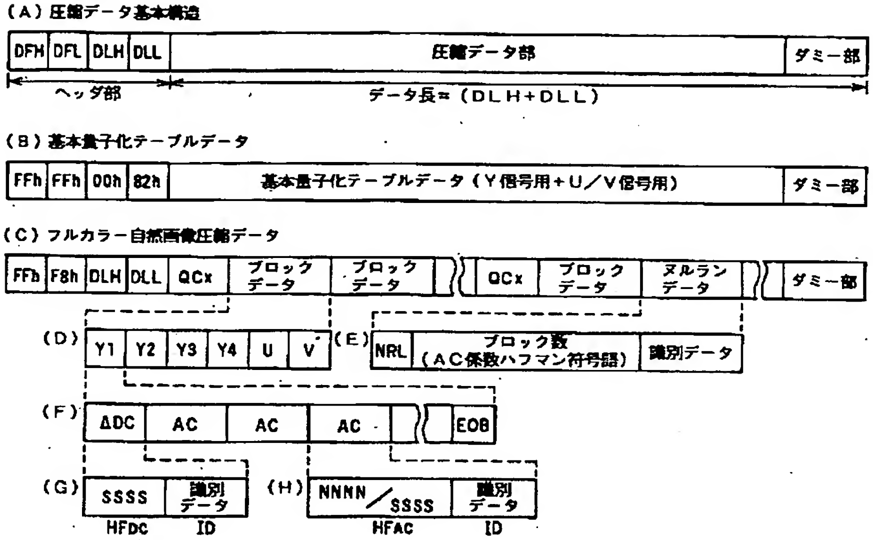
(C) AC係数符号化

・ジグザグスキャン ： $\underbrace{0,\ -4},\ \underbrace{0,\ 3},\ \underbrace{4},\ \underbrace{0,\ 0,\ 5}$

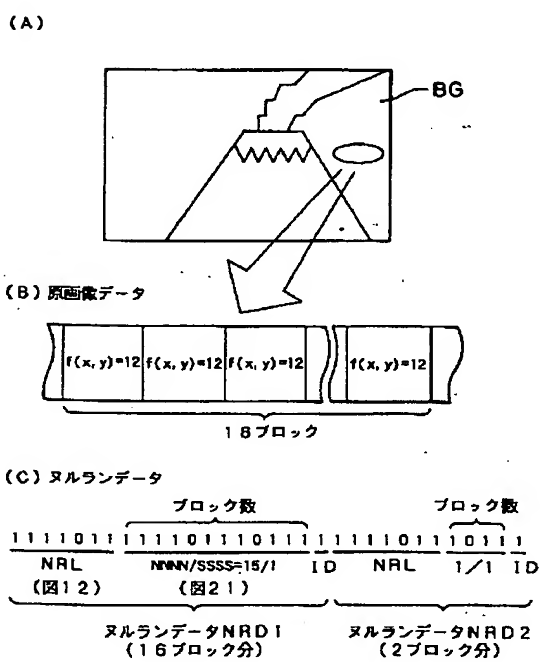
・NNNN／SSSS＝ 1／3　1／2　0／3　2／3

・ $HF_{AC}+ID = \underbrace{1110100}_{HF_{AC}}\underbrace{011}_{ID}\underbrace{11001}_{HF_{AC}}\underbrace{11}_{ID}$

【図１８】



【図２０】



【図２１】

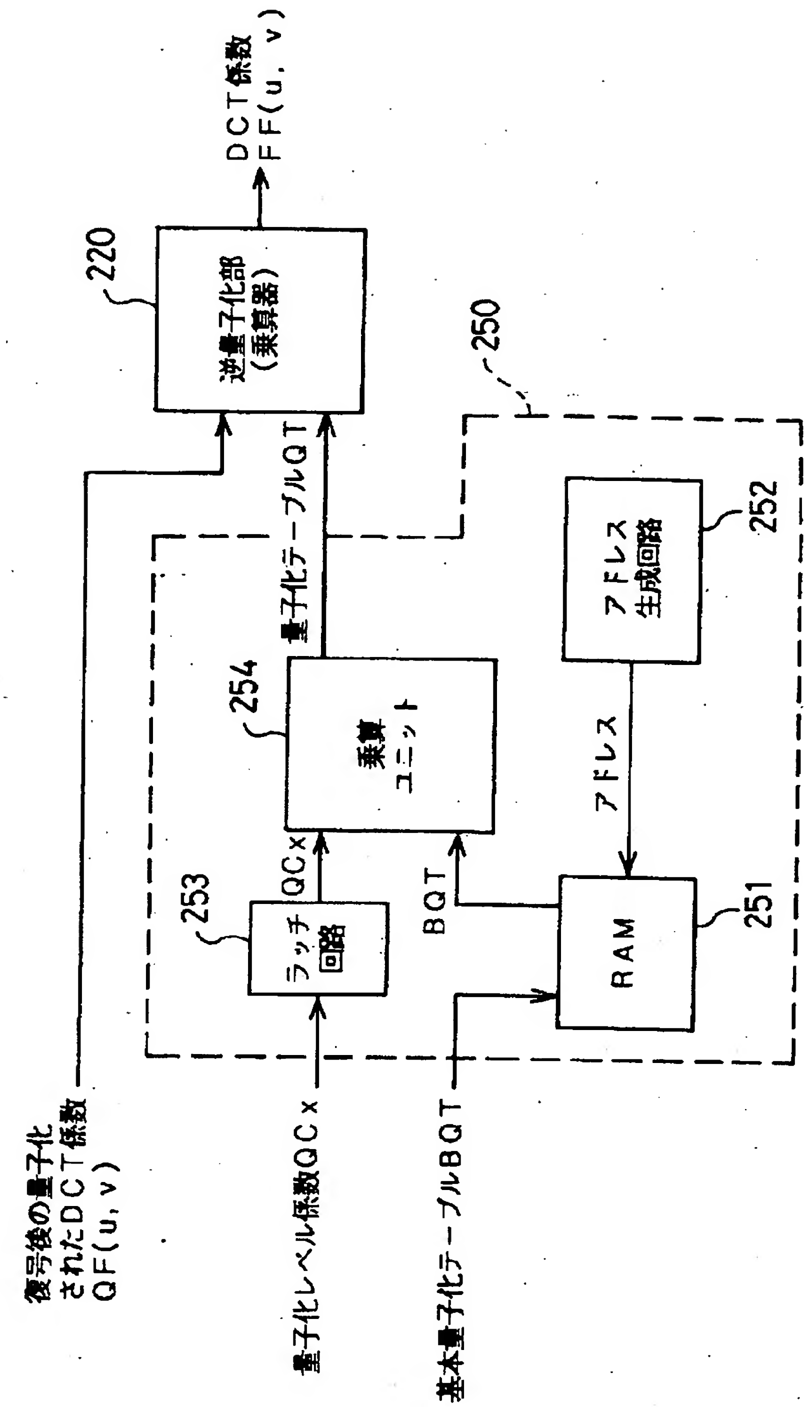
ゼロラン長 NNNN ／ カテゴリ SSSS	ＡＣ係数ハフマン符号語ＨＦＡＣ	
	Ｙ信号用	Ｕ信号、Ｖ信号用
0/1	00	00
1/1	1011	100
2/1	11010	1011
3/1	110111	11010
4/1	111000	11011
5/1	111001	111000
6/1	1110110	1110101
7/1	111011101	1110110
8/1	111100111111	111011101
9/1	111101000111	111101000111
10/1	111101001111	111101001111
11/1	111101010111	111101010111
12/1	111101011111	111101011111
13/1	111101100111	111101100111
14/1	111101101111	111101101111
15/1	111101110111	111101110111

ヌルランデータに使用する場合：

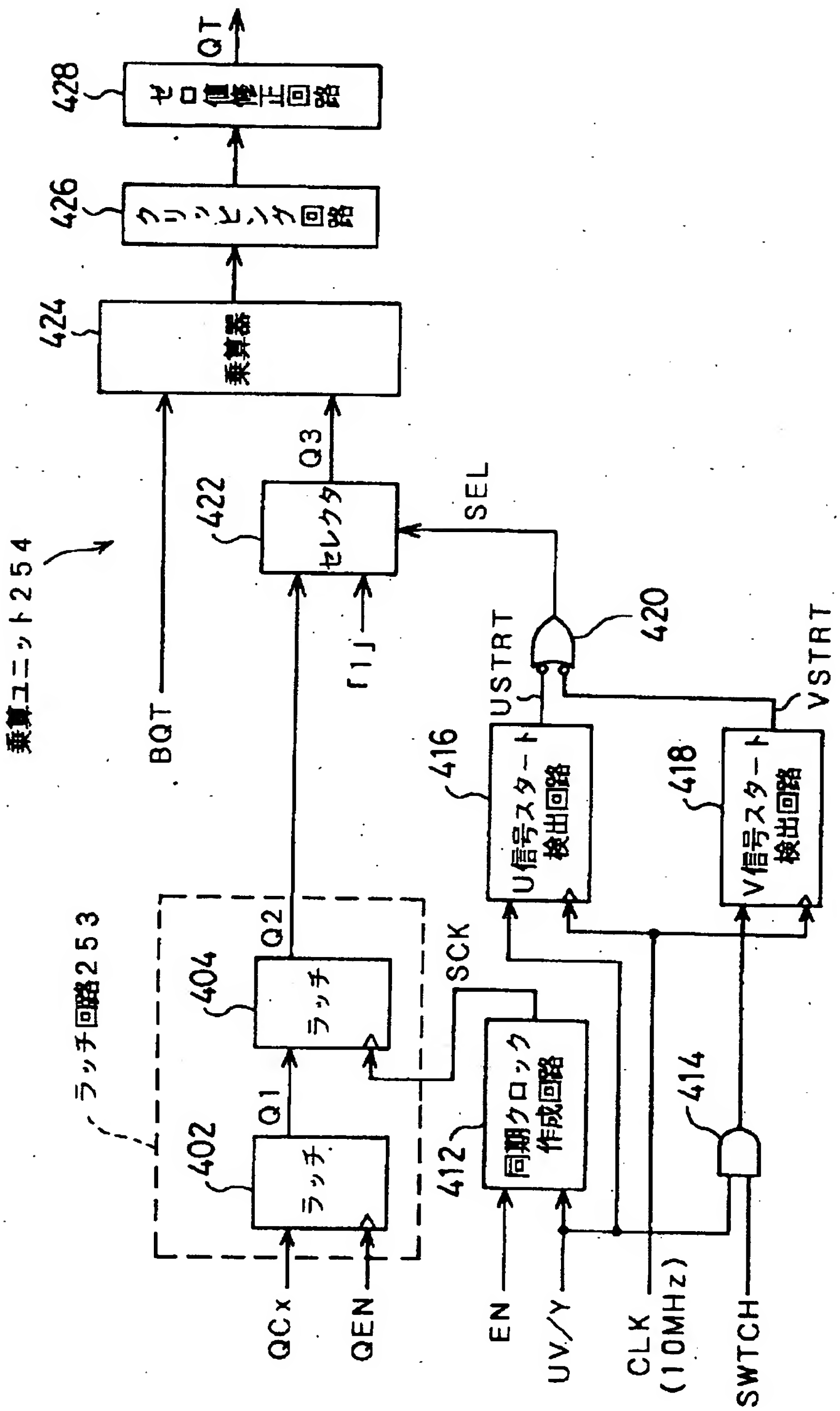
ＮＮＮＮ＝［ブロック数］－１

ＳＳＳＳ＝１

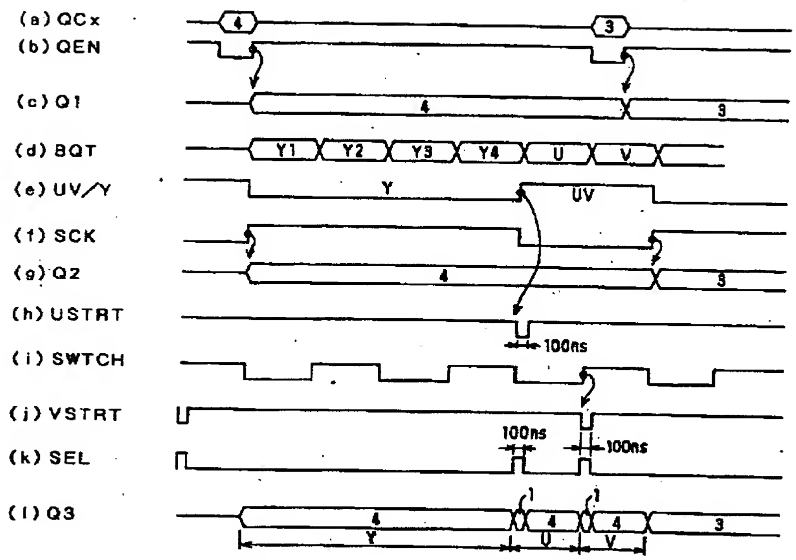
【図２２】


220
逆量子化部
（乗算器）
ＤＣＴ係数
ＦＦ(ｕ，ｖ)
250
量子化テーブルＱＴ
252
アドレス
生成回路
254
乗算
ユニット
アドレス
253
ＱＣｘ
ラッチ
回路
ＢＱＴ
ＲＡＭ
251
復号後の量子化
されたＤＣＴ係数
ＱＦ(ｕ，ｖ)
量子化レベル係数ＱＣｘ
基本量子化テーブルＢＱＴ

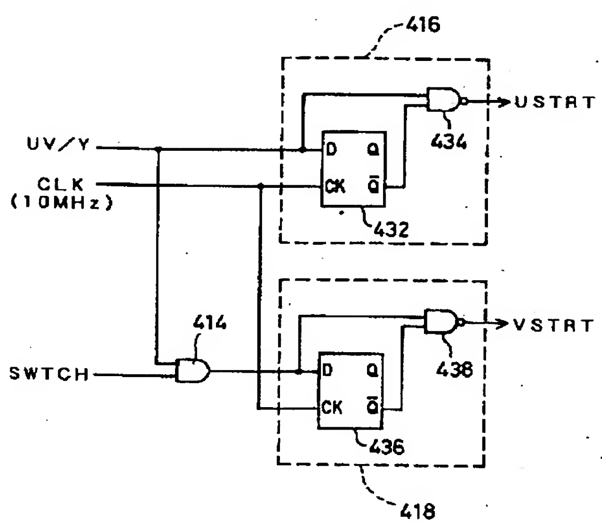
【図２３】


乗算ユニット２５４
ラッチ回路２５３
402
ラッチ
404
ラッチ
Q1
Q2
QCx
QEN
EN
UV/Y
CLK
(10MHz)
SWTCH
412
同期クロック作成回路
SCK
414
416
U信号スタート検出回路
418
V信号スタート検出回路
USTRT
VSTRT
420
SEL
422
セレクタ
「1」
BQT
Q3
424
乗算器
426
クリッピング回路
428
ゼロ値修正回路
QT

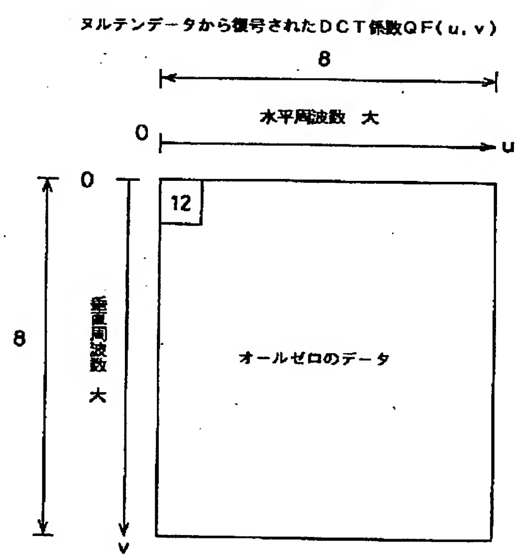
【図２４】


(a) QCx
(b) QEN
(c) Q1
(d) BQT
(e) UV／Y
(f) SCK
(g) Q2
(h) USTRT
(i) SWTCH
(j) VSTRT
(k) SEL
(l) Q3
Y1
Y2
Y3
Y4
U
V
Y
UV
100ns
100ns
100ns

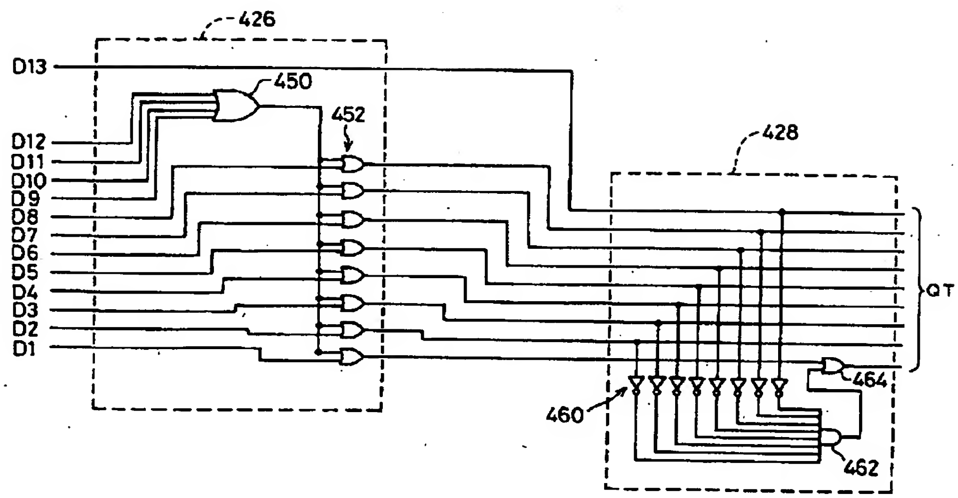
【図２５】


416
USTRT
UV／Y
CLK (10MHz)
D
Q
CK
434
432
414
VSTRT
SWTCH
438
436
418

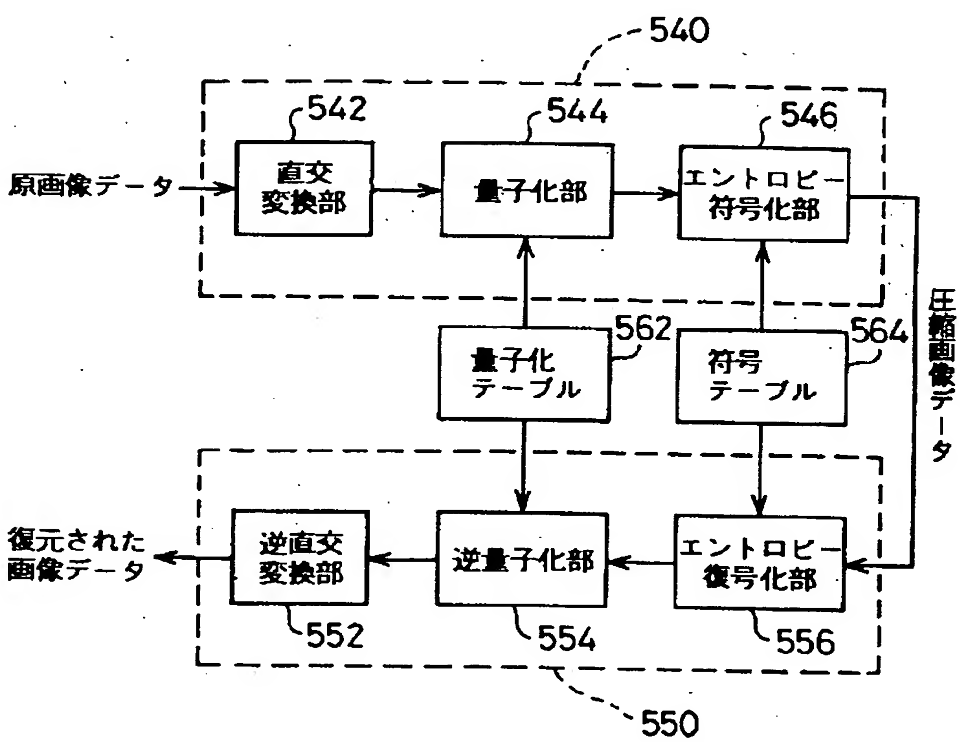
【図２８】


ヌルテンデータから復号されたDCT係数QF(u, v)
8
水平周波数 大
0
u
0
12
8
垂直周波数 大
オールゼロのデータ
v

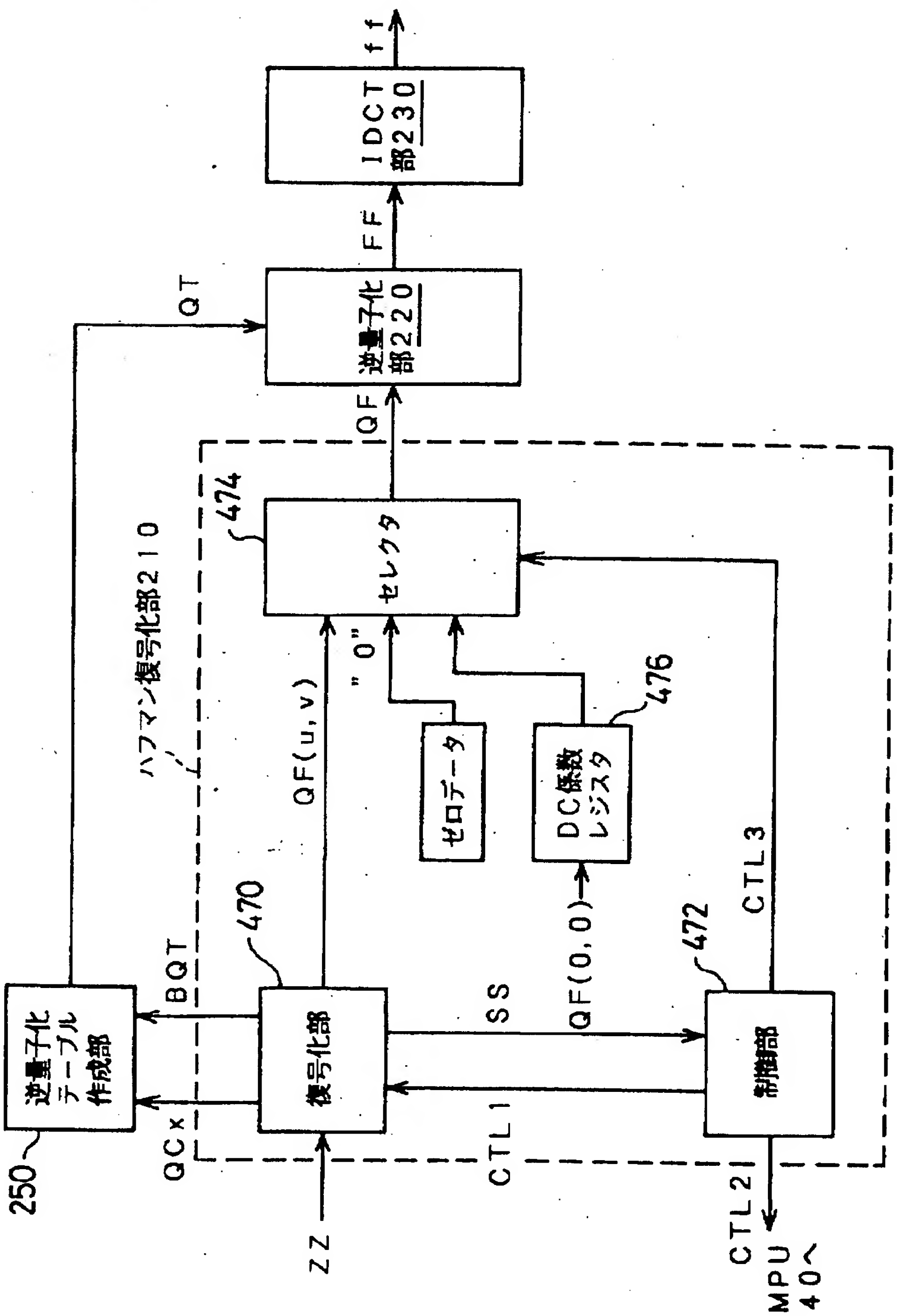
【図26】


426
D13
450
452
D12
D11
D10
D9
D8
D7
D6
D5
D4
D3
D2
D1
428
QT
464
460
462

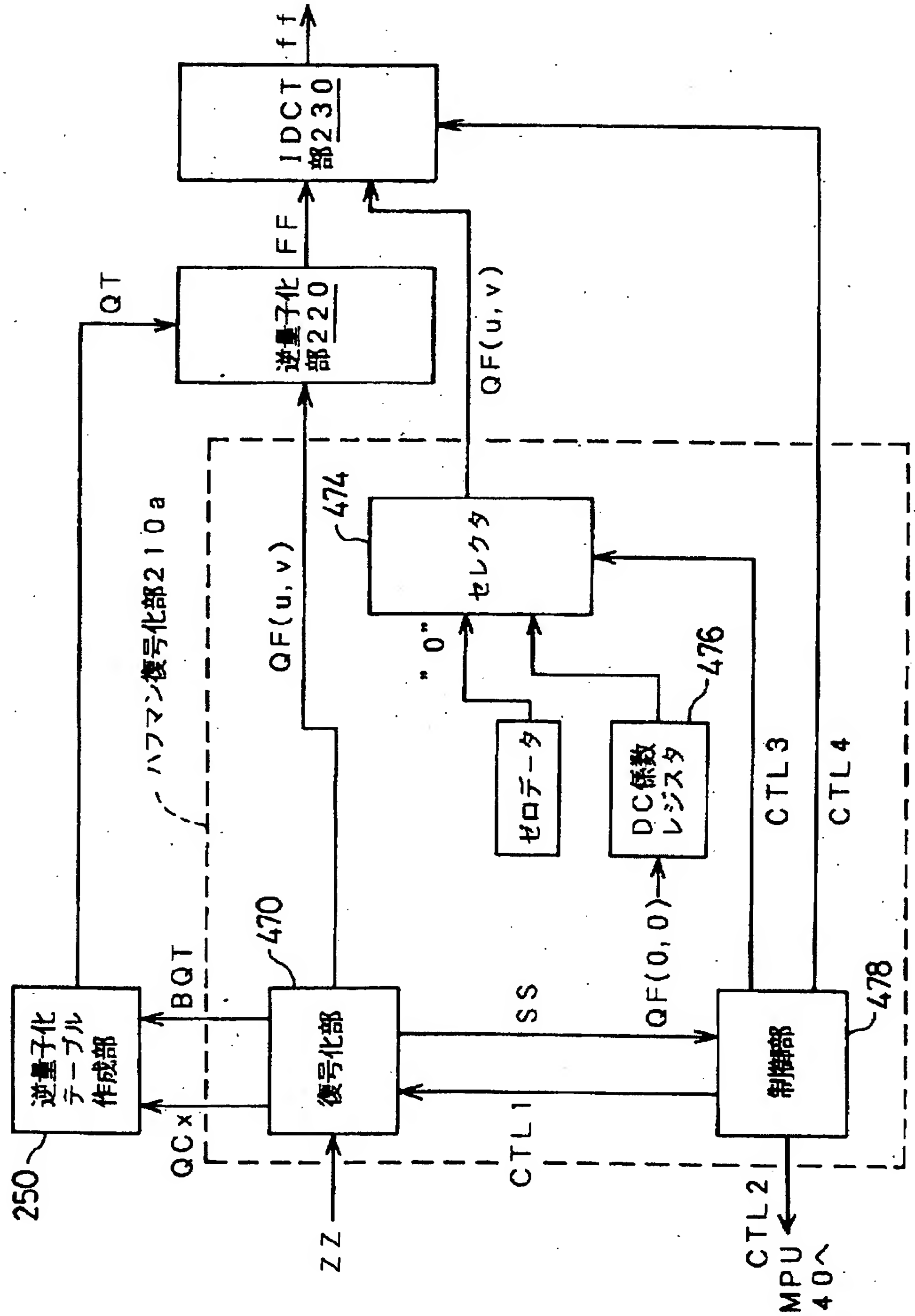
【図31】


540
542
544
546
原画像データ
直交変換部
量子化部
エントロピー符号化部
圧縮画像データ
量子化テーブル
562
符号テーブル
564
復元された画像データ
逆直交変換部
逆量子化部
エントロピー復号化部
552
554
556
550

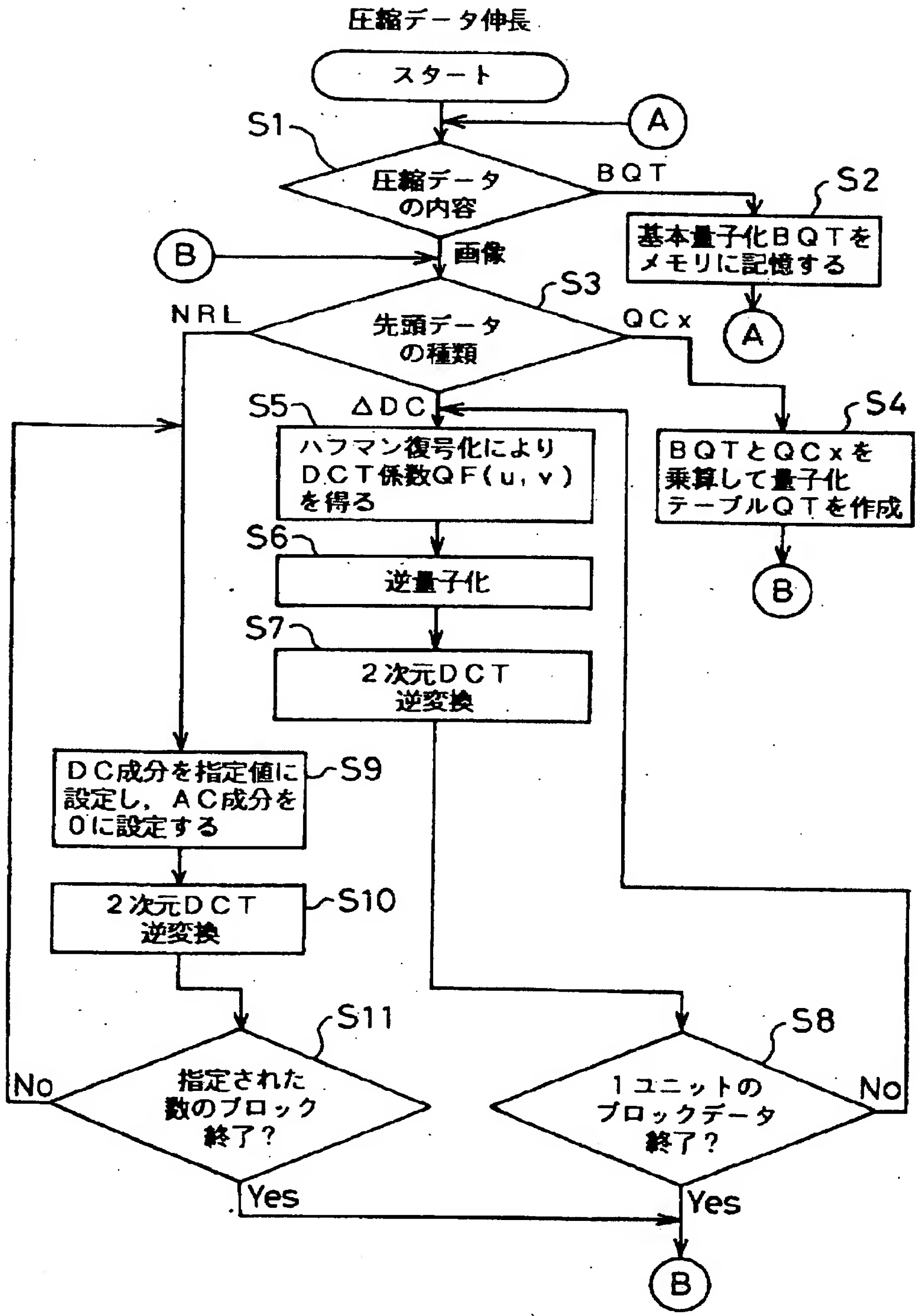
【図27】


IDCT部230
ff
FF
逆量子化部220
QT
QF
セレクタ
474
"0"
ゼロデータ
DC係数レジスタ
476
QF(u,v)
ハフマン復号化部210
CTL3
QF(0,0)
472
470
BQT
SS
逆量子化テーブル作成部
復号化部
制御部
QCx
CTL1
250
ZZ
CTL2
MPU40へ

【図29】


IDCT部230
ff
FF
逆量子化部220
QT
QF(u,v)
ハフマン復号化部210a
474
セレクタ
"0"
476
ゼロデータ
DC係数レジスタ
QF(u,v)
CTL3
CTL4
470
BQT
SS
QF(0,0)
478
逆量子化テーブル作成部
復号化部
制御部
QCx
CTL1
250
ZZ
CTL2
MPU40へ

【図３０】


圧縮データ伸長
スタート
S1
圧縮データの内容
BQT
S2
基本量子化BQTをメモリに記憶する
A
B
画像
S3
NRL
先頭データの種類
QCx
S4
BQTとQCxを乗算して量子化テーブルQTを作成
S5
ΔDC
ハフマン復号化によりDCT係数QF(u, v)を得る
S6
逆量子化
S7
2次元DCT逆変換
S9
DC成分を指定値に設定し，AC成分を0に設定する
S10
2次元DCT逆変換
S11
指定された数のブロック終了？
No
Yes
S8
1ユニットのブロックデータ終了？
No
Yes
B

フロントページの続き

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